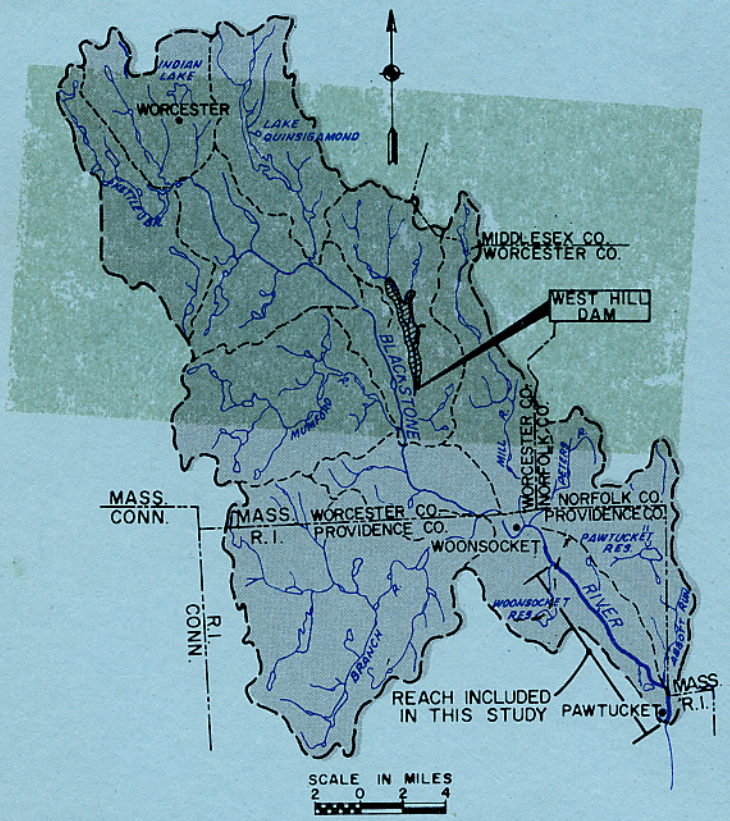
FLOOD PLAIN INFORMATION

BLACKSTONE RIVER

CUMBERLAND, LINCOLN, CENTRAL FALLS AND PAWTUCKET

RHODE ISLAND



PREPARED BY
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS
JUNE 1971

INTRODUCTION

This report discusses the flood situation along the Blackstone River from the lower Woonsocket city line in Rhode Island downstream to the Old Slater Mill Dam in Pawtucket. It was prepared at the request of the Town Administrators of Cumberland and Lincoln and the Mayors of Central Falls and Pawtucket through the Rhode Island Division of Harbors and Rivers to aid in the solution of local flood problems created by the Blackstone River and in the best utilization of land subject to overflow. It is intended to encourage those affected to help themselves.

The report is based on information relative to rainfall, runoff, historical flood heights and other technical data bearing upon the frequency and size of floods in the study area. Residents along the river have been interviewed and newspaper files and historical documents have been searched for information concerning past floods. From these investigations and from studies of possible future floods on the Blackstone River, the local flood situation, both past and future, has been developed.

Two phases of the flood situation along the river are covered in this report. The first presents a record of the largest known historic

floods in the area. The second presents probable flood levels in the event of a recurrence of the historic floods or an occurrence of an Intermediate Regional Flood, or a Standard Project Flood. (See page 3)

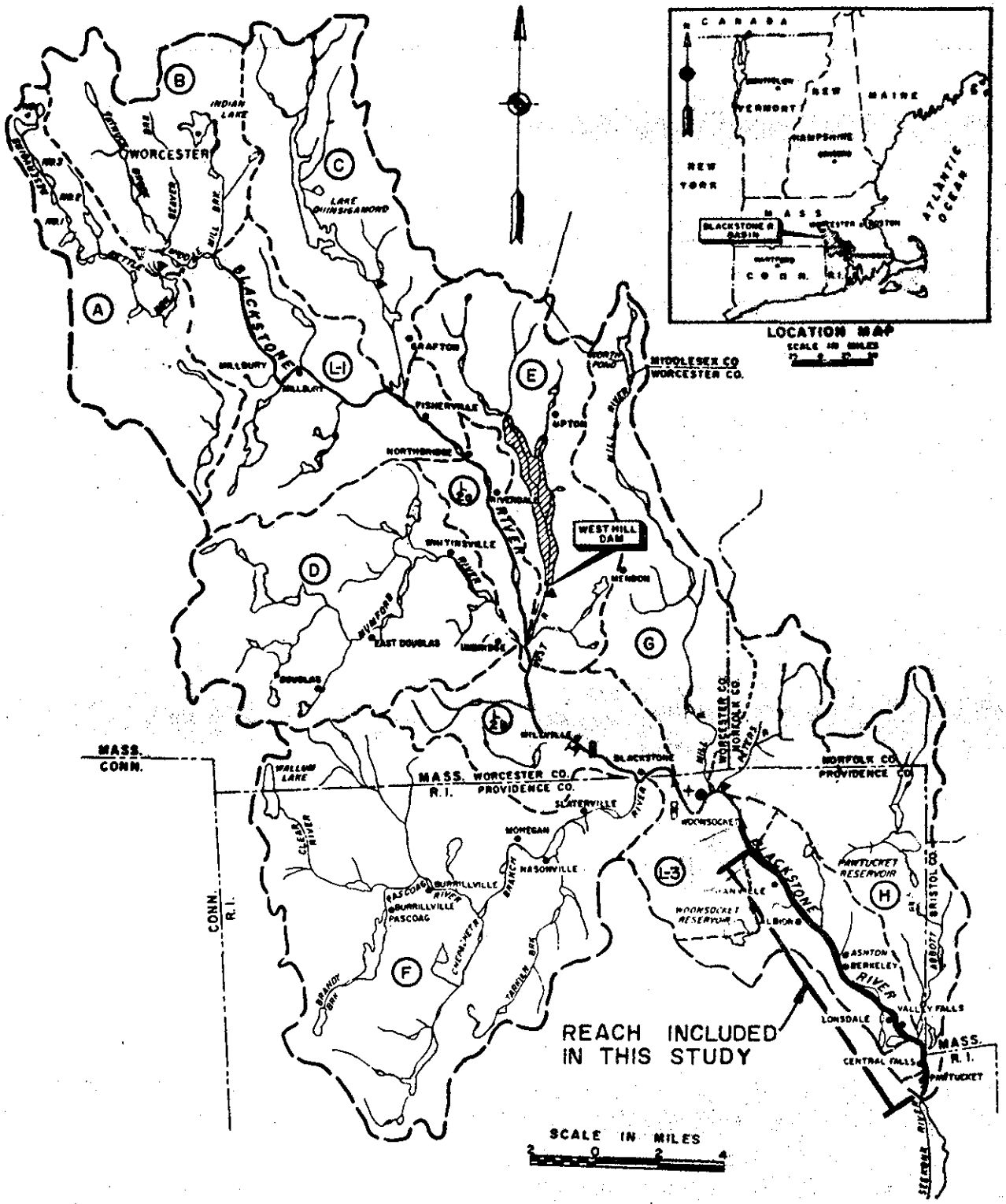
Appropriate consideration should be given to the possible future occurrence of historic floods, the Intermediate Regional Flood, and the Standard Project Flood in problems concerned with the control of developments in the flood plains of the lower Blackstone River, and in reaching decisions as to the size of floods to consider for this purpose.

Maps, profiles, and cross sections which show the extent of flooding that has been experienced and that which might occur in the future in the Cumberland, Lincoln, Central Falls and Pawtucket areas are included in this report. From the profiles and cross sections, the probable depth of flooding at any location in the study area may be obtained. With this information floor levels for buildings may be planned high enough to avoid flood damage or, at lower elevations, with recognition of the chance and hazards of flooding that are being taken.

The report does not include plans for the solution of flood problems. Rather, it is intended to provide the basis for further study and planning on the part of local governments in arriving at

solutions to minimize vulnerability to flood damages. This involves local planning programs to guide developments by controlling the type of use made of the flood plain through zoning and subdivision regulations, the construction of flood protection works, or a combination of the two.

The New England Division of the Corps of Engineers will, upon request, provide technical assistance to Federal, State and local agencies in the use of the information contained herein and will provide other available data for flood plain management and use.



NOTE

(A) — DRAINAGE AREA DESIGNATION (SEE TABLE I)

FLOOD PLAIN INFORMATION
BLACKSTONE RIVER

BASIN MAP

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. I

CONTENTS

CONTENTS (Continued)

TABLES

FIGURES

FIGURES (Continued)

PLATES

SUMMARY OF FLOOD SITUATION

The towns of Cumberland and Lincoln and the cities of Central Falls and Pawtucket which comprise the study area, are located in northern Rhode Island. This report covers the 10.6 miles of the Blackstone River from the lower Woonsocket city line downstream to the Old Slater Mill Dam in Pawtucket, Rhode Island (see Plate 1).

Discharge information for the study area are obtained by relating to the U.S. Geological Survey stream gaging station on the Blackstone River in Woonsocket, Rhode Island which has been in operation since 1929. Whenever floods occur in the lower Blackstone River basin, they are now reduced (modified) by the U.S. Army Corps of Engineers flood control dam and reservoir (West Hill Dam) located on the West River in Uxbridge, Massachusetts. This flood control project, which was built subsequent to the August 1955 flood of record, has been in operation since 1961.

Most of the residential and business development in the study area is on high ground above flood danger from the Blackstone River. However, there remains residences and commercial and industrial developments along the river which have been inundated by floods of the past and remain susceptible to floods in the future.

The following paragraphs summarize the significant findings which are discussed in more detail in succeeding sections of this report.

* * *

THE GREATEST FLOOD known to have occurred on the Blackstone River in recent times was in August 1955. Newspapers point out the disastrous proportion of this flood in the area and leave no doubt that it was far greater than any other flood. Records show that the maximum discharge was the greatest since at least 1645.

* * *

OTHER GREAT FLOODS in March 1968, July 1938 and March 1936 were about equal in magnitude and are considered the second highest floods in the Blackstone River. Highwater marks indicate that these floods were within two to three feet of equaling the 1955 flood.

* * *

OTHER FLOODS of lesser magnitude since 1900 occurred in November 1927, September 1938, September 1954 and October 1955. Historical records indicate that floods occurred in 1818, 1876, 1877, 1886 and 1887, however, information on these events are meager in most cases.

* * *

INTERMEDIATE REGIONAL FLOOD is a flood that has an average frequency of occurrence in the order of once in 100 years, or in each year there is a 1% chance of occurrence and could occur twice in the same year. The frequency is determined from an analysis of floods on the Blackstone River and other streams in the same general area. The analysis indicates that elevations of the Intermediate Regional Flood for this stream would be about 1.5 to 4.5 feet higher than the flood elevations in March 1968.

* * *

STANDARD PROJECT FLOOD on the Blackstone River represents an estimated flood condition which is considered to be possible. It is not practical to assign a frequency to the Standard Project Flood as the occurrence of such a flood would be a rare event, however, it could occur in any year. In this study, this flood would have a stage about 4.5 to 13.0 feet higher than the 1968 flood. Floods larger than the Standard Project Flood are possible and should not be overlooked in the study of any problem.

* * *

FLOOD DAMAGE that would result from the recurrence of major known floods would be substantial. Extensive damages would be caused by the Standard Project Flood because of its wider extent, greater depths and higher velocities.

* * *

MAIN FLOOD SEASONS for the Blackstone River are spring and fall. Most of the higher floods have resulted from heavy rains accompanying tropical hurricanes. Floods, however, could occur in any month.

* * *

HAZARDOUS CONDITIONS would occur during large floods as a result of the rising stream, high water velocities and deep flood water levels.

* * *

FLOOD DAMAGE PREVENTION MEASURES in the lower Blackstone River basin consists of the flood control reservoir at West Hill in Uxbridge, Massachusetts. This will help reduce the damages along this reach of the Blackstone River to some degree. Flood protection measures in Woonsocket, Rhode Island and Blackstone and Auburn, Massachusetts will have no effect in this area.

* * *

FUTURE FLOOD HEIGHTS of the August 1955 flood, the Intermediate Regional Flood and the Standard Project Flood related to the most recent major flood which occurred in March 1968 are shown on Table 1. The table shows the comparison of the flood heights along the Blackstone River at various locations.

TABLE 1

Relative Flood Heights

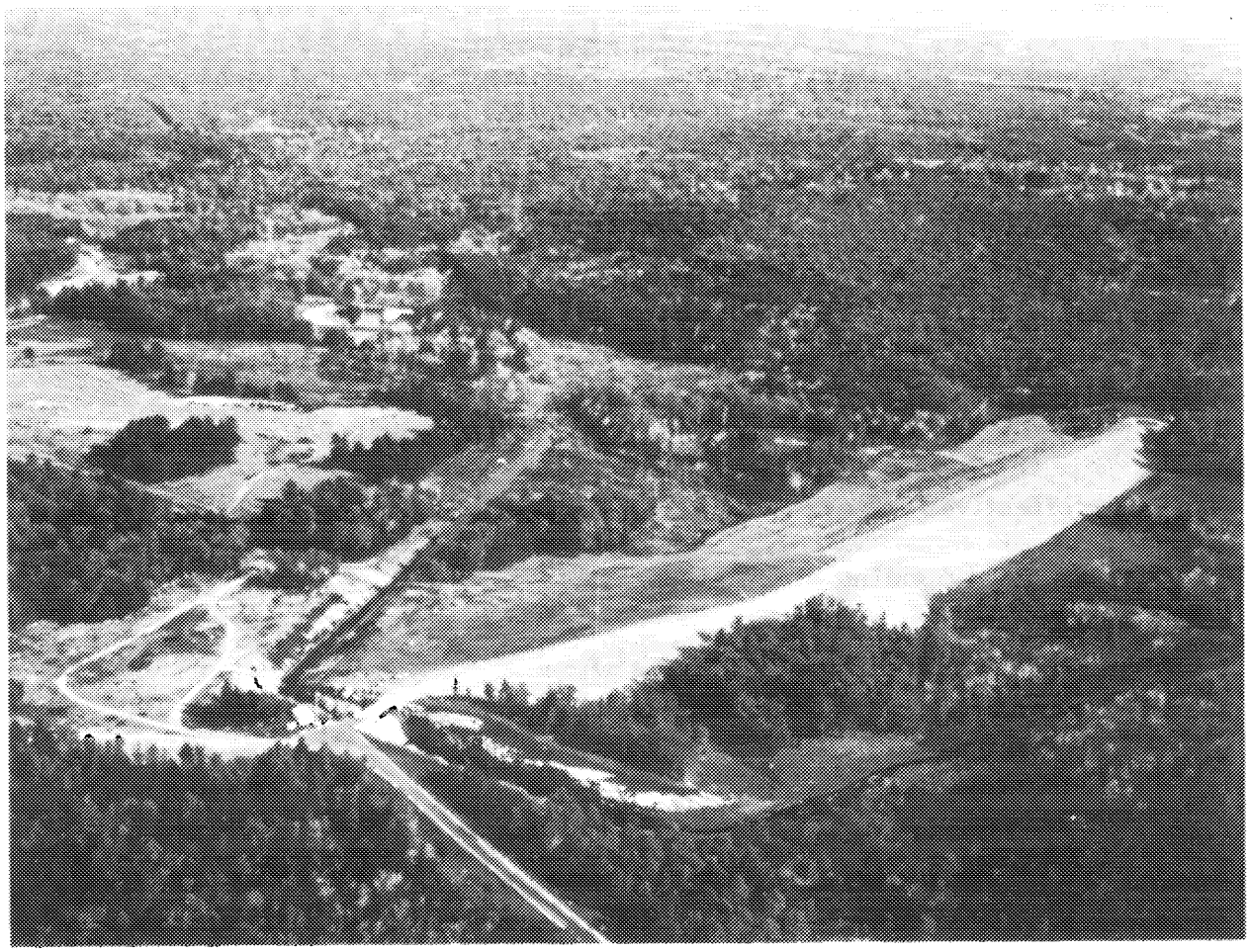
FLOOD	ABOVE 1968 FLOOD (IN FEET) UPSTREAM MANVILLE DAM	GEO. WASHINGTON HIGHWAY BRIDGE	NEW POND AREA	VALLEY POND AREA	UPSTREAM SLATER MILL DAM
MARCH 1968	0.0	0.0	0.0	0.0	0.0
AUGUST 1955	2.5	4.2	2.7	4.1	2.5
INTERMEDIATE REGIONAL	1.5	2.6	1.6	2.3	1.3
STANDARD PROJECT	5.5	6.2	5.2	6.4	4.6

GENERAL CONDITIONS

Flood Damage Prevention Measures

Since 1936, the New England Division, Corps of Engineers has been active in a program of investigating the possibility of constructing flood control reservoirs in the various river basins in New England. Five flood control projects have been constructed in the Blackstone River basin. These consist of one dam and reservoir (West Hill Dam) on the West River in Uxbridge, Massachusetts (see Plate 1 and Figure 1), one local protection project each in Worcester and Blackstone, Massachusetts and two local protection projects in Woonsocket, Rhode Island.

West Hill Dam and Reservoir is the only project which affects flood discharges in the study area. It is located on the West River about 3 miles above the confluence of the Blackstone River in the northeast corner of Uxbridge, Massachusetts. Construction of the 2,400 foot rolled earthfill dam was completed in June 1961. At spillway crest, the West Hill Reservoir has a capacity of 12,400 acre-feet which is equivalent to about 8.3 inches of runoff from the drainage area of 27.9 square miles. When filled, the reservoir is about 4.5 miles long, with a surface area of 1,025 acres.



AERIAL VIEW OF WEST HILL DAM

Figure 1

The Worcester Diversion project diverts flood discharges away from the city of Worcester and the Woonsocket local protection projects provide protection to the city of Woonsocket only. The Woonsocket Falls Dam which is part of the Woonsocket local protection project, detains a small portion of flood discharges in its pool, however, the dam is equipped with tainter gates to maintain its pool and is not designed for the purpose of storing flood waters.

Flood prevention measures on local and private levels consist of sandbagging and shoring low-lying structures and low bank areas. Their effectiveness are contingent on the action taken following the warning of impending storms.

Flood Warning and Forecasting Service

The U. S. Department of Commerce, National Weather Service, is responsible for forecasting high water on the nation's rivers and for issuing flood warnings for the protection of life and property. The National Weather Service River Forecast Center at Hartford, Connecticut is responsible for issuing flood warnings for the Blackstone River basin. A comprehensive network of rainfall and river data reporting stations have been established with cooperative observers. The flood warnings

are issued by teletype simultaneously to the press services, State Police, Civil Defense and many other State and local agencies. In the event of communication failure, the State Police and Civil Defense have an emergency plan for receiving flood warnings and notifying the responsible officials.

It should be reiterated that a flood warning system is only one phase of preventative flood damage measures. The other phase is the preparation of Federal and local governments and private citizens to combat the impending storm. Without a sufficient storm warning and an ability to react to the warning, the residences, industrial and commercial establishments in low-lying areas will be defenseless against the raging flood waters of the Blackstone River.

In addition to the flood warning and forecasting service, the Corps of Engineers operates an Automatic Hydrologic Radio Reporting Network. This network, under computer programmed control, will immediately provide read-out information which is essential for the regulation of flood control dams. Two stations on the Blackstone River in Northbridge, Massachusetts and Woonsocket, Rhode Island report river stages. The real time print-out on the computer will assure early warning to Division personnel of high stream flows for immediate operation of West Hill Dam.

The Stream and Its Valley

The towns of Cumberland and Lincoln, and the cities of Central Falls and Pawtucket comprise the lower portion of the Blackstone River basin. The entire basin is located in south-central Massachusetts and northern Rhode Island. It is generally elongated in shape with a length of about 41 miles, average width of 12 miles and a total drainage area of 478 square miles. The topography is generally hilly with higher elevations lying in the western portion, some of which are in excess of 1,300 feet msl. Because of short, steep tributaries in the upper reaches of the watershed and relatively longer ones in the lower reaches, there is a tendency for tributary flows to synchronize with the crest on the main river. A map showing the entire Blackstone River basin and the portion of the basin within the study area is shown on Plate 1. A breakdown of drainage areas within the basin is shown on Table 2.

The Blackstone River originates at the junction of the Middle River and Mill Brook in the southern part of Worcester, Massachusetts and flows in a generally southeasterly direction for 44 miles to its mouth at the Main Street dam in Pawtucket, Rhode Island. From this point the river is known as the Seekonk River and becomes a

TABLE 2

Drainage Areas

Designation[1]	Tributary Area	Drainage Area (Square Miles)	
(A)	Kettle Brook	31.3	
(B)	Tatnuck and Mill Brooks	30.0	
(L-1)	Local - Worcester to Northbridge	42.7	
(C)	Quinsigamond River	35.0	
	Blackstone River at Northbridge		139
(L-2a)	Local - Northbridge to Branch River	27	
(D)	Munford River	58	
(E)	West River	35	
(F)	Branch River	96	
(L-2b)	Local-Branch River to Woonsocket	14	
(G)	Mill and Peters River	47	
	Blackstone River at Woonsocket		416
(L-3)	Local - Woonsocket to Pawtucket	37	
(H)	Abbott Run	25	
	Blackstone River at Pawtucket		478

(1) See Plate 1

tidal estuary. The Blackstone River has a total fall of about 440 feet from its source to sea level. From Worcester to Fisherville, a distance of approximately 10 miles, the river falls 150 feet or about 15 feet per mile. In the next 18 miles to Blackstone, Massachusetts the average fall is only about 5 feet per mile. The river valley in this reach is broad and flat and has a marked modifying effect on floods in the basin. Downstream of Blackstone, the river drops 75 feet in 3 miles, then flattens out to become a rather uniform slope of approximately 11 feet per mile to tidewater. Plate 3 is an index map of the plates that show the flooded areas in the study reach. Plans and profiles are shown on Plates 4 to 14.

Developments in the Flood Plain

Judging from the horizontal limits of flooding, except for a few isolated areas, most of the flood plain is located between the George Washington Highway Bridge (Rte. 116) and the Broad Street Bridge. The extent of the damages are contingent on the height of the structures, the value of inventory, and the magnitude of the flood. The larger areas within this reach are the New Pond area and the Valley Falls Pond area.

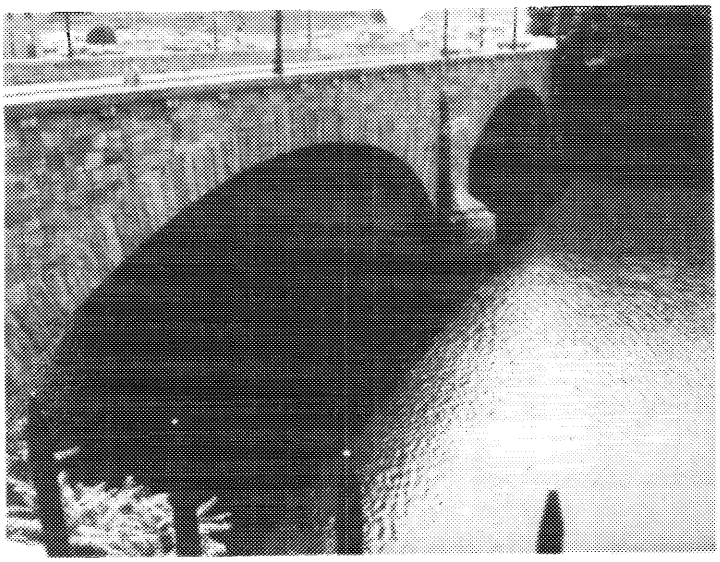
Water is detained in the New Pond area by Pratt Dam which has five gate openings on the left bank which pass normal river flows. Within the New Pond area, extensive fill has been placed and a sanitary land fill operation has been conducted, hence this can no longer be considered an effective flood plain which could retard and store flood waters.

The Valley Falls Pond area is in the backwater of Sayles Dam in Central Falls and Pawtucket. The topography of the area is very irregular consisting generally of low lands and marshes.

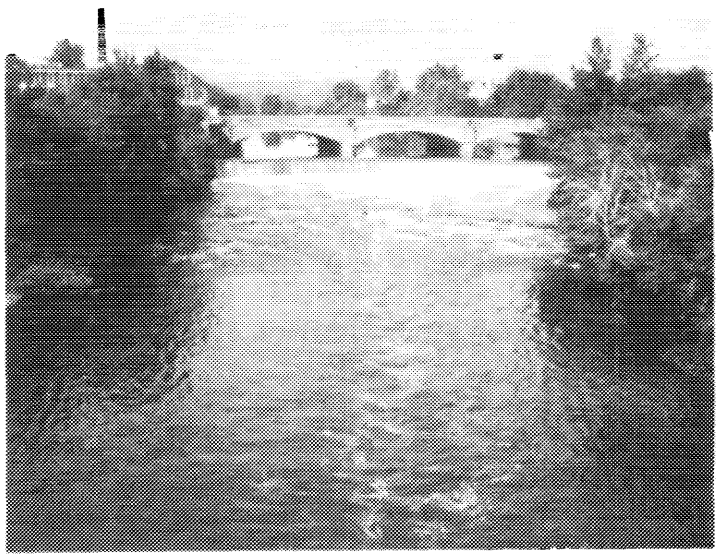
Bridges across the River

Fifteen bridges cross the Blackstone River within the study area. Views of some of the bridges are shown on Figures 2 and 3. Table 3 lists pertinent elevations for these structures and shows their relation to the crest of the Intermediate Regional Flood.

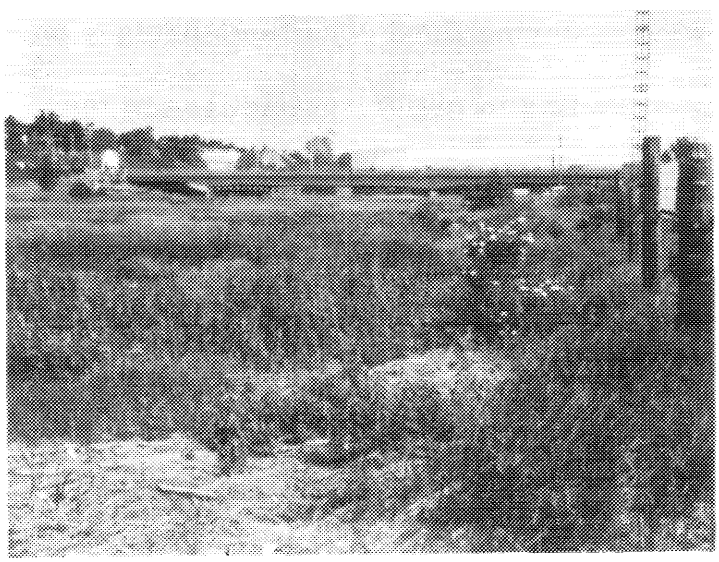
Under normal flow conditions the bridges generally act as minor hydraulic controls. However, during flood conditions bridges become clogged with debris resulting in major restrictions to the river channel. All approaches to the bridges appear adequate and do not obstruct normal river flows. Elevations of the bridges and their relationship to flood profiles are shown on Plates 4 to 14.



Exchange Street Bridge
(looking upstream)



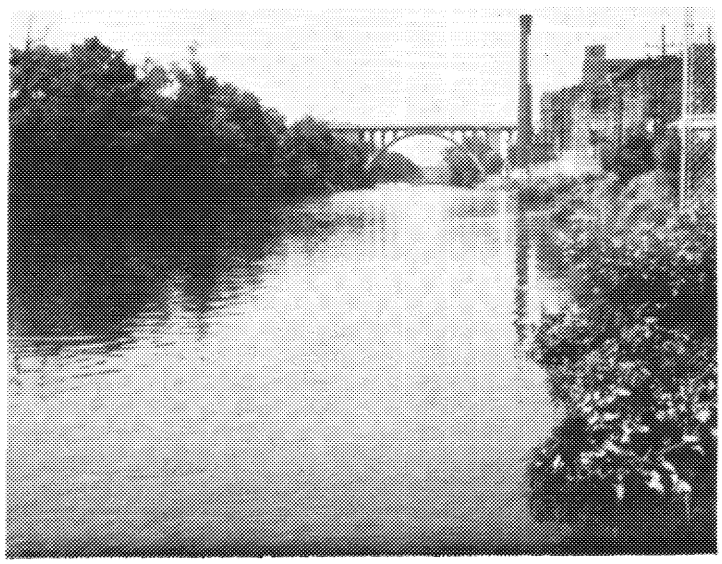
Broad Street Bridge
(looking upstream)



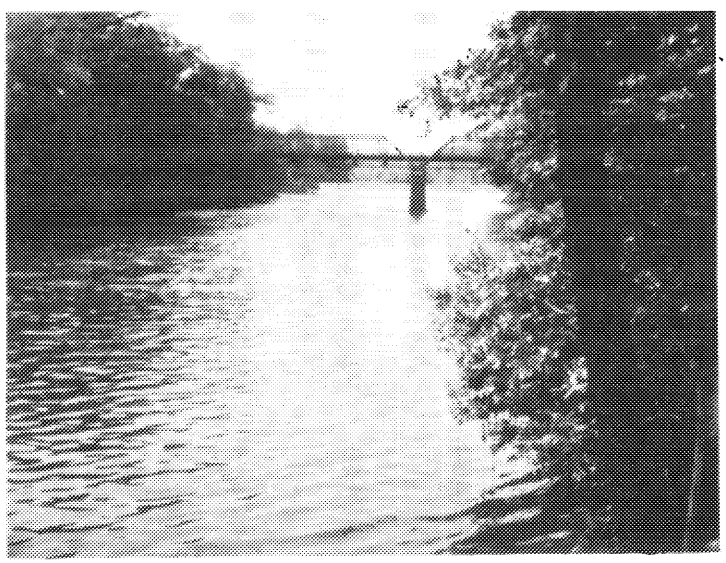
John Street Bridge
(looking upstream)

Figure 2

Martin Street Bridge
(looking upstream)



George Washington
Highway Bridge
(looking upstream)



Albion Road Bridge
(looking upstream)

Figure 3

TABLE 3

BRIDGES ACROSS THE BLACKSTONE RIVER

Station	Identification	Stream Bed Elev. ft.	Floor Elev. ft. msl	Intermediate Regional Flood Crest Elev. ft. msl	Standard Project Flood Crest Elev. ft. msl	Underclearance Elev. ft. msl	Underclearance Above Intermediate Regional Flood ft.	Underclearance Below Intermediate Regional Flood ft.
10+50	Exchange St.	17.9	51.3	36.7	44.7	46.0	9.3	
32+80	Central Ave.	19.5	46.2	40.0	45.2	38.0		2.0
45+20	Roosevelt Ave.	27.7	53.6	47.8	53.3	49.8	2.0	
63+50	Penn Central Railroad	28.8		49.7	56.7	59.5	9.8	
97+40	Penn Central Railroad	34.5		53.0	61.6	62.4	9.4	
102+40	Broad St.	38.8	65.3	61.3	65.5	62.2	0.9	
156+30	John St.	44.8	68.3	62.6	67.6	64.2	1.6	
188+50	Whipple	46.5	67.2	64.7	68.1	63.7		1.0
208+00	Penn Central Railroad	49.8	72.1	68.4	71.9	69.0	0.6	
289+80	Martin St.	58.8	84.8	73.1	77.5	80.7	7.6	

TABLE 3 (Cont'd)

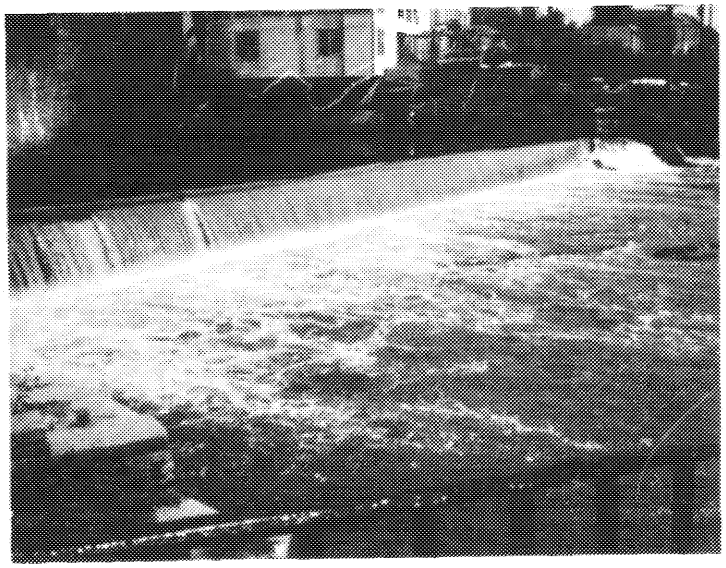
BRIDGES ACROSS THE BLACKSTONE RIVER

Station	Identification	Stream Bed Elev. ft.	Floor Elev. ft. msl	Intermediate Regional Flood Crest Elev. ft. msl	Standard Project Flood Crest Elev. ft. msl	Underclearance Elev. ft. msl	Underclearance Above Intermediate Regional Flood ft.	Underclearance Below Intermediate Regional Flood ft.
333+00	Geo. Washington Hwy. - Rte. 116	61.5	139.5	77.4	81.1	134.5	57.1	
357+30	Interstate 295 East	63.0	149.0	84.0	89.0	144.0	60.0	
358+40	Interstate 295 West	63.2	149.0	84.8	90.8	144.0	59.2	
406+40	Penn Central Railroad	69.8	90.3	90.1	93.4	82.3		7.8
412+90	Albion Rd.	71.9	95.7	92.8	99.8	92.2		0.6
507+60	Manville Rd.	87.0	120.0	101.7	106.6	115.0	13.3	

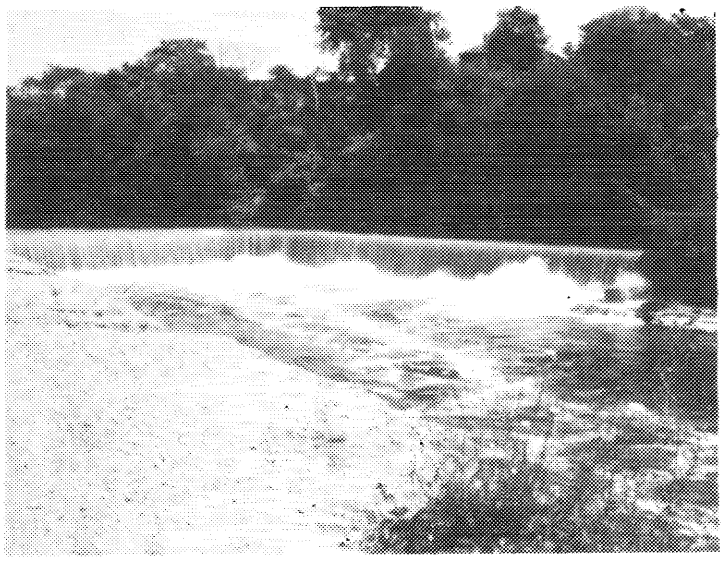
Dams on the Blackstone River

During the 19th century, several small dams were constructed across the river to develop water power for industrial plants located along its banks. In recent years, a number of industrial plants have been abandoned and the dams are no longer being used. Several dams on the Blackstone River and its tributaries above Woonsocket, Rhode Island, were damaged during the August 1955 flood, and some of the peak stages experienced in the basin were the result of surges of water which were released when these dams failed.

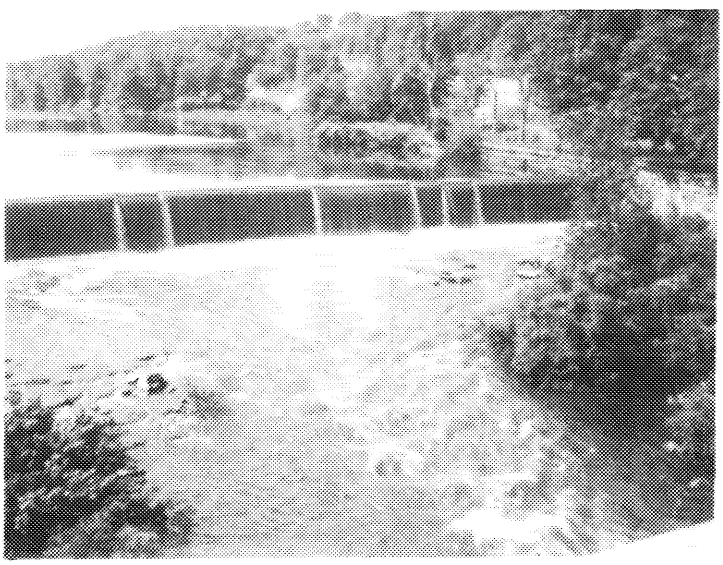
Presently seven dams cross the Blackstone River within the study reach. These dams have a modifying effect on flood discharges by storing and detaining flood waters in their respective pools. Photographs of some of the dams are shown on Figure 4. Pertinent data of the structures are given in Table 4.



Slater Mill Dam



Pantex Dam
(note "L" shaped
spillway)



Manville Dam

Figure 4

TABLE 4

DAMS ON BLACKSTONE RIVER

Station feet	Identification	Drainage Area sq. mi.	Crest Elev. ft. msl	IRF Crest ft. msl	SPF Crest ft. msl	Depth over Dam IRF ft.	Depth over Dam SPF ft.
0 + 00	Slater Mill Dam	478	24.9	32.4	35.7	7.5	10.8
40 + 00	Pantex Dam	473	35.8	45.0	49.2	9.2	13.4
101 + 00	Sayles Dam	445	50.3	60.1	64.8	9.8	14.5
208 + 00	Pratt Dam	443	60.8	68.4	71.9	7.6	11.1
342 + 50	Ashton Dam	439	73.6	81.5	85.0	7.9	11.4
418 + 00	Albion Dam	433	87.7	96.5	100.8	8.8	13.1
507 + 60	Manville Dam	430	106.7	114.5	118.5	7.8	11.8

FLOOD SITUATION

This section of the report is a history of floods on the Blackstone River in Cumberland, Lincoln, Central Falls and Pawtucket, Rhode Island. The portion of the Blackstone River studied extends from Slater Mill Dam in Pawtucket to the Woonsocket town line, a distance of approximately 10.7 miles.

Flood Records

There are thirteen U.S. Geological Survey gaging stations in the Blackstone River basin. The first records of river stages and discharges were at Forestdale, Rhode Island on Branch River and date back to 1886. Two stations are located on the Blackstone River in Northbridge, Massachusetts and Woonsocket, Rhode Island.

The U.S. Geological Survey gaging station at Woonsocket, Rhode Island (d.a. = 416 sq. mi.), is located just upstream of the study reach. The station measures runoff from 85 percent of the entire Blackstone River basin of 478 square miles and has been in operation since 1929. Flood discharges in the study area are estimated from information supplied by this gaging station.

To supplement the record obtained at this gaging station, local residents were interviewed for information on dates and heights of

floods. Newspaper files were searched, as were historical documents and records. Valuable data was obtained from reports of field investigations and surveys made after floods. These records and investigations have developed a knowledge of floods on the Blackstone River since the turn of the century. Table 5 is a record of the five highest known floods in order of magnitude at the gaging station.

Duration and Rate of Rise

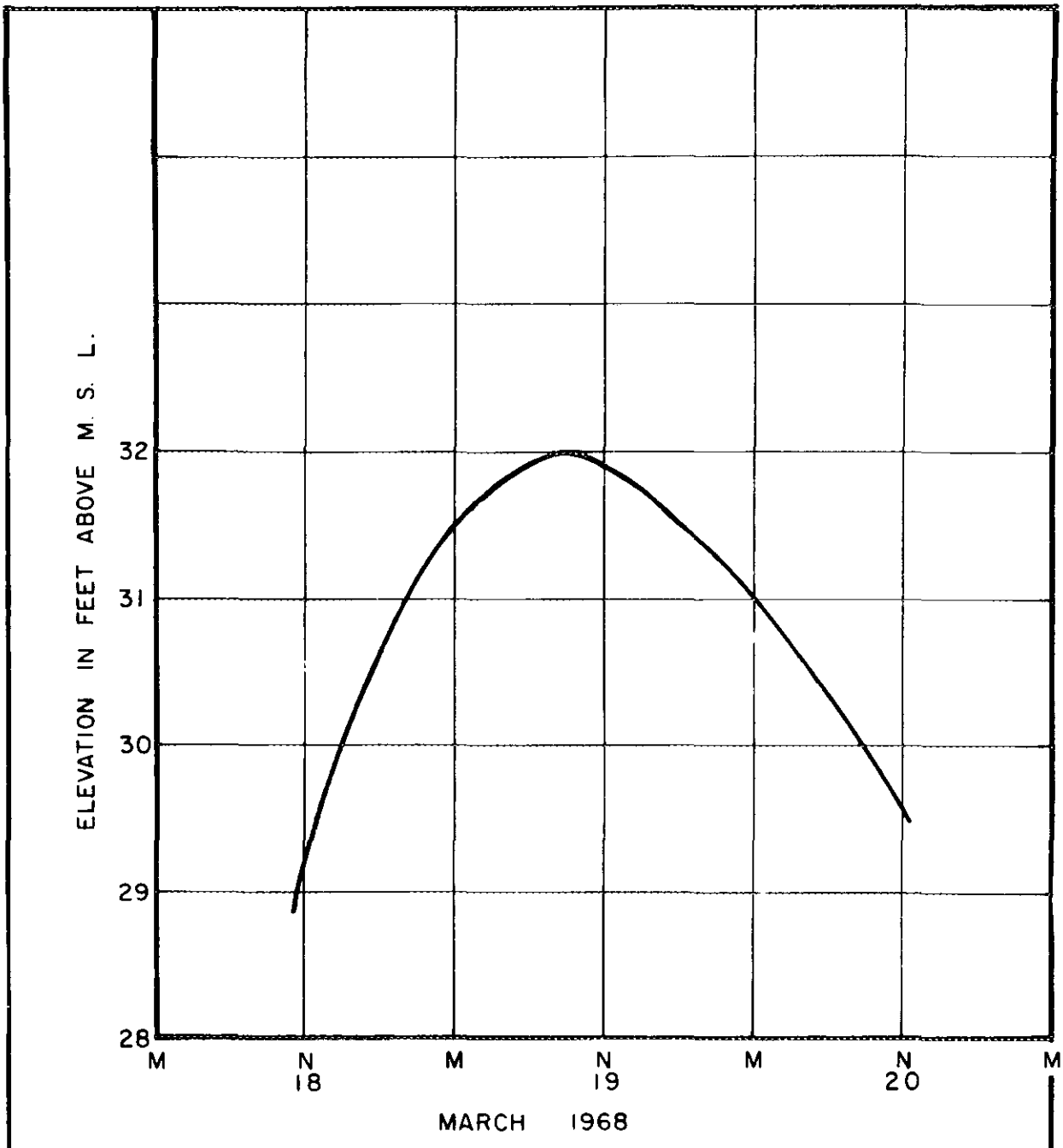
Plate 2 shows the estimated stage hydrograph on the Blackstone River in the rear of City Hall in Pawtucket for the March 1968 flood. During this flood the river rose to its crest stage in about 40 hours at an average rate of 3 inches per hour.

Velocities

During the March 1968 flood it is estimated that velocities in the channel of the Blackstone River in Pawtucket ranged up to 9 feet per second.

Flooded Area, Flood Profiles and Cross Sections

The approximate areas along the Blackstone River in the Cumberland to Pawtucket area that would be inundated by a modified August 1955, a recurring March 1968 flood, an Intermediate Regional



FLOOD PLAIN INFORMATION

BLACKSTONE RIVER AT PAWTUCKET, RHODE ISLAND

FLOOD HYDROGRAPH

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 2

TABLE 5

FIVE HIGHEST KNOWN FLOODS IN ORDER OF MAGNITUDE

BLACKSTONE RIVER AT WOONSOCKET, RHODE ISLAND

Event date	Discharge cfs
August 19, 1955	32,900
March 1, 1968*	15,400
July 24, 1938	15,100
March 19, 1936	15,000
October 17, 1955	8,710

* Modified by West Hill Flood Control Dam.

Flood, and a Standard Project Flood are shown on Plates 4 to 14. The actual limits of these overflow areas on the ground may vary some from those shown on the maps because the contour intervals and scale do not permit precise plotting of the flooded areas. The high water profiles of the above floods are also shown on these plates. These profiles as well as Tables 3 (Bridges), 4 (Dams) and 6 (Cross Sections) should be used to determine the depth of flooding for a particular location. This can be done by standard survey methods using the nearby dams, bridges, or bench marks for a reference.

The profiles for the stream were computed by using stream characteristics for selected reaches as determined from flow records, topographic maps, and valley cross sections which were surveyed in July 1968. The overflow areas and the elevations on Plates 4 through 14 have been determined with an accuracy consistent with the purposes of this study and the accuracy of the basic data.

The profiles of the Standard Project Flood and the Intermediate Regional Flood depend in part upon the degree of clogging of various bridges during the flood. Because it is impossible to forecast these events, it was assumed that the clogging of bridge openings would be similar as experienced during the August 1955 and March 1968 floods.

TABLE 6

FLOOD HEIGHTS AT CROSS SECTIONS ON BLACKSTONE RIVER

No.	Station	Standard Project Flood	Intermediate Regional Flood	August 1955 Flood	March 1968 Flood
		Elevation in Feet Above Mean Sea Level			
1	9+55	38.2	34.5	36.1	32.5
2	11+50	44.5	36.8	39.8	33.0
3	31+25	44.6	37.8	40.7	33.5
4	33+85	45.2	40.0	41.9	37.8
5	44+75	49.6	45.5	47.1	43.5
6	46+00	53.3	47.8	49.4	45.0
7	62+20	54.0	48.5	51.0	45.5
8	64+70	56.7	49.8	52.2	46.2
9	95+75	58.4	51.5	54.4	48.0
10	98+50	61.5	53.2	55.9	49.0
11	114+40	65.6	61.5	63.3	59.0
12	155+50	66.0	61.7	63.7	59.5
13	157+00	67.6	62.5	64.7	60.3
14	187+70	67.8	63.4	65.1	61.5
15	189+40	68.2	64.7	66.4	62.5
16	205+90	68.4	65.5	66.8	64.0
17	209+80	72.0	68.6	70.1	67.1
18	262+15	75.1	71.1	72.6	68.8
19	288+80	76.8	72.6	74.4	69.8
20	291+00	77.6	73.3	76.4	71.0
21	328+75	80.5	76.6	78.6	74.4
22	332+25	80.6	76.7	78.7	74.5
23	333+85	81.2	77.5	79.2	75.0
24	357+00	88.4	83.8	85.5	81.6
25	359+20	90.8	84.9	86.7	82.4
26	403+80	97.5	88.9	91.1	84.9
27	412+30	98.9	90.6	93.1	86.2
28	413+50	99.7	92.8	95.4	88.2
29	503+00	104.2	100.2	101.6	98.2
30	562+90	119.8	116.2	117.0	114.6

Plate 15 shows four selected river cross sections that are typical of the total of 30 river cross sections surveyed for this study. The elevations which would occur during a recurring August 1955, and during an Intermediate Regional and Standard Project Flood are also shown on these cross sections.

The flood profiles shown on Plates 4 through 14 also indicate high water marks which were obtained by surveys following the March 1936, August 1955 and March 1968 floods. It should be noted that the March 1936 and August 1955 floods reflect natural discharges and the March 1968 high water marks reflect flood flows which were modified by the West Hill flood control dam built subsequent to the August 1955 flood.

FLOOD DESCRIPTIONS

Floods on the Blackstone River may be expected to occur during any season of the year. Early spring rains combined with melting snow resulted in the floods of March 1936 and 1968. Heavy rains during summer and fall months caused the floods of November 1927, July 1938, September 1954, October 1955 and the record flood of August 1955. The following paragraphs briefly describe the more important storms which have occurred in the past.

August 1955

The greatest flood on the Blackstone River, according to available records, occurred in August 1955. See Figure 5. The flood, resulting from the "Hurricane Diane" storm on the Blackstone River and its principal tributaries, was approximately twice the magnitude of any flood of record. Several days prior to the occurrence of the flood, "Hurricane Connie" deposited nearly five inches of rainfall on the basin which saturated the ground and filled the many lakes and mill ponds. However, the runoff associated with this storm failed to cause any significant rise in the rivers.

During the afternoon of 17 August rainfall accompanying "Hurricane Diane" began and increased in intensity to such a degree that

Fig. [illegible]

AUGUST 1955 FLOOD ON BLACKSTONE RIVER

accumulations in excess of five inches were recorded by nightfall of the 18th. Heavy rainfall continued throughout the evening of the 19th until the storm finally moved out to sea, leaving an average of twelve inches over the basin with total accumulations ranging from eight to fifteen inches.

A few newspaper excerpts of this flood are as follows . . . .

. . . . Blackstone River reached its highest flood stage in history, the river rose $3\frac{1}{2}$ inches per hour (between 12:45 AM to 1:45 AM). . . .

. . . . In Central Falls, residents between the Blackstone River and High Street were alerted to evacuate. . . .

. . . . Lonsdale Sports Arena was filled with water. . . .

. . . . North of John Street a Drive-in Theater being built was filled with water. . . .

. . . . All buildings on the river side of Roosevelt Avenue to the old police station reported flooding. . . .

. . . . Water ran over the retaining wall just south of the Exchange Street bridge and flooded the Municipal building area. . . .

. . . . Slater Mill threatened. . . water filled the basement and covered the first floor. . . .

Other Great Floods

Other great floods of nearly equal magnitude occurred in March 1936, July 1938 and most recently in March 1968. Each one of these floods is considered the second highest flood on the Blackstone River. The magnitude of the March 1968 flood would have been about 10 percent greater than the 1936 and 1938 floods, if it had not been reduced by the West Hill flood control dam.

March 1936

The March 1936 flood actually occurred as two peaks of almost equal magnitude six days apart. The first peak, slightly less than the second, was the result of a combination of rainfall which varied from 3 inches in the lower part of the basin to 7 inches in the upper part. The second peak fell on already saturated soil which reduced the rate of infiltration and, therefore, contributed in producing runoff coefficients as high as 90 percent.

The following are excerpts from newspapers concerning the March 1936 flood in the study area.

. . . . Homes were evacuated in Central Falls on Courtland Street and Notre Dame Plat. . . .

. . . . Masurel Worsted Company, Samoset Mills, and Nyanza Mills closed . . . water was 7 feet deep around the Masurel plant. . . .

. . . .John Plush Mills had 5 feet of water on grounds. . . .

. . . .In Lincoln and Cumberland, the Blackstone overflowed its banks ... Mendon Road from Broad Street, Cumberland to John Street, Lincoln was closed with water 1 foot deep in highway. . . .

. . . .Between Whipple bridge and grade crossing of N.Y., N.H. & H Railroad in Lonsdale a distance of 500 yards of State Highway 122 was flooded . . . .

. . . .Lowlands south of Whipple Bridge and John Street was completely flooded. Early yesterday morning John Street baseball field was like a Mill Pond. . . .

July 1938

During the period of July 17-25, 1938 an irregular series of showers and thunderstorms deposited widely varying concentrations of water over the eastern seaboard. The total precipitation exceeded 10 inches through eastern Connecticut and Massachusetts and northwestern Rhode Island. The individual storms within the 8 day period was not unusual in themselves, but the rapid sequence in which they succeeded one another prevented the streams from recovering normality during the intervening intervals. Consequently, the streams were pushed to successively higher stages in a series of peaks.

Numerous textile mills, homes and highways in the lower part of the Blackstone River basin were inundated by the flood which was their highest flood of record until August 1955.

March 1968

During this storm a total of 4.96 inches of rainfall was recorded at Hillsgrove U.S. National Weather Service station. The storm spanned a three day period from March 17 to March 19. Snow depths and water equivalents in New England were nearly normal. Most of the water thus contained was released due to the rain and accompanying thawing temperatures during the storm. Frozen ground surfaces during most of the storm meant very little water was able to percolate into the ground. Most of the rain and snowmelt, therefore, was converted into runoff, flooding basements along the way, causing rapid rises on small ponds, brooks, and streams and finally . . . more slowly but quite predictably . . . near record crests on the Blackstone River.

Some newspaper excerpts are as follows:

. . . . The Pawtucket Water Department faced an emergency as water from the Blackstone River flooded its water purification plant in Cumberland. . . .

. . . . The Sayles Finishing Plant Complex off Walker Street in Lincoln was hard hit. . . .

. . . . The warehouse of Roger Williams Grocery Co. off Mountain Street in Cumberland was surrounded by 6 feet of water. . . .

. . . . Several small industries and the large Lonsdale Bleachery Complex were inundated by flood waters. . . .

. . . . Mendon Road in Cumberland from the Lincoln town line to Broad Street was closed after it became inundated. . . .

. . . . Flood conditions forced closing of the westbound lanes of the George Washington Highway from the Cumberland line to the H & H Screw Co. in Lincoln. . . Also closed because of flooding was the Martin Street Bridge in Cumberland. . . .

. . . . In Central Falls, cellars were flooded in 15 homes in the Notre Dame Plat adjacent to the Blackstone River. . . .

. . . . In Pawtucket, the Blackstone River was 6.5 feet above normal and there was extensive damage in city streets. . . .

FUTURE FLOODS

In developing the flood picture of a river basin, consideration should be given to those floods which have occurred and to those floods which could occur in the future. The following paragraphs describe an Intermediate Regional Flood and a Standard Project Flood in the vicinity of Cumberland, Lincoln, Central Falls and Pawtucket, Rhode Island. A flood comparable to the Standard Project Flood can reasonably be expected. The Intermediate Regional Flood may be expected to occur more frequently but will not be as severe as the Standard Project Flood.

Large floods have been experienced in the past on streams in the general geographical and physiographical region of the study area. Heavy storms similar to those causing these floods could occur over the watershed of the Blackstone River. In this event, floods would result on this stream comparable in size with those experienced on neighboring streams. It is therefore desirable, in connection with any determination of future floods which may occur on the Blackstone River, to consider storms and floods that have occurred in the region on watersheds whose topography, watershed cover and physical characteristics are similar to those of this stream.

DETERMINATION OF INTERMEDIATE REGIONAL FLOODS

The Intermediate Regional Flood is defined as a flood having an average frequency of occurrence in the order of once in 100 years at a designated location, although the flood may occur in any year. For this reason, the Intermediate Regional Flood is better described as a flood with a 1% chance of occurring each year.

In order to determine the Intermediate Regional Flood for the Blackstone River, statistical studies were made using the more than 39 years of records of known flood data at the U.S.G.S. gage at Woonsocket, Rhode Island.

Results of the studies indicate that the Intermediate Regional Flood on the Blackstone River at the Woonsocket gaging station would have a peak discharge of about 22,000 cubic feet per second. At Slater Mill Dam in Pawtucket the peak discharge for the Intermediate Regional Flood would be about 23,700 cubic feet per second. These would be less in magnitude than the August 1955 flood. Peak discharges are shown on Table 7.

DETERMINATION OF STANDARD PROJECT FLOOD

Only in rare instances has a specific stream experienced the largest flood that is likely to occur. Severe as the maximum known flood may have been on any given stream, it is a commonly accepted fact that, in practically all cases, sooner or later a larger flood can and probably will occur. The Corps of Engineers, in cooperation with the National Weather Service, has made broad and comprehensive studies and investigations based on the vast records of experienced storms and floods and has evolved generalized procedures for estimating the flood potential of streams. These procedures have been used in determining the Standard Project Floods. It is defined as the largest flood that can be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical region involved.

Peak discharges of the Standard Project Flood on the Blackstone River at the Woonsocket gaging station would be 40,000 cubic feet per second. Results of the study also indicate that there would be a peak discharge of 43,000 cubic feet per second at Slater Mill Dam in Pawtucket during a Standard Project Flood. Peak discharges are shown on Table 7.

TABLE 7

PEAK DISCHARGES

Event date	U. S. G. S. Gage Woonsocket, R. I. d. a. = 416 sq. mi. c. f. s.	Slater Mill Dam Pawtucket, R. I. d. a. = 478 sq. mi. c. f. s.
August 1955 Flood*	26,100	26,600
March 1968 Flood	15,400	17,000
Intermediate Regional Flood	22,000	23,700
Standard Project Flood	40,000	43,000

* Modified by West Hill Flood Control Dam.

Frequency

It is not practical to assign a frequency to the Standard Project Flood. The occurrence of such a flood would be a rare event; however, it could occur in any year.

Possible Larger Floods

Floods larger than the Standard Project Flood are possible; however, the combination of factors that would be necessary to produce such floods would seldom occur. The consideration of floods of this magnitude is of greater importance in some problems than in others but should not be overlooked in the study of any problem.

HAZARDS OF GREAT FLOODS

The amount and extent of damage caused by any flood depends in general upon how much area is flooded, the height of flooding, the velocity of flow, the rate of rise, and the duration of flooding.

Areas Flooded and Heights of Flooding

The areas along the Blackstone River flooded by the Standard Project Flood and the Intermediate Regional Flood and depth of flooding are shown on Plates 4 through 14.

The profiles for the streams were computed by using stream characteristics for selected reaches as determined from observed flood profiles, topographic maps and valley cross sections. The elevations and the overflow areas have been determined with an accuracy consistent with the purposes of this study and the accuracy of this data.

The profiles of the Standard Project Flood and the Intermediate Regional Flood depend in part upon the degree of destruction or clogging of various bridges during the flood. Because it is impossible to forecast these events, it was assumed that all bridge structures would stand, and that no clogging would occur.

The Standard Project Flood profile for Blackstone River is 4.5 to 13.0 feet higher than the March 1968 flood.

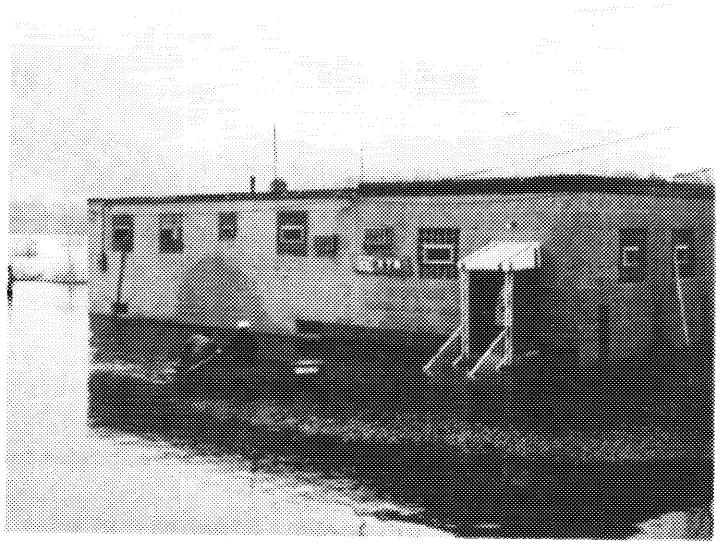
The Intermediate Regional Flood profile for Blackstone River is 1.5 to 4.5 feet higher than the March 1968 flood.

Figures 6 through 10 show the heights that were experienced by the March 1968 and by the August 1955 floods. Also shown are the predicted Standard Project Flood and the Intermediate Regional Flood on facilities presently existing on the flood plains in the study area.

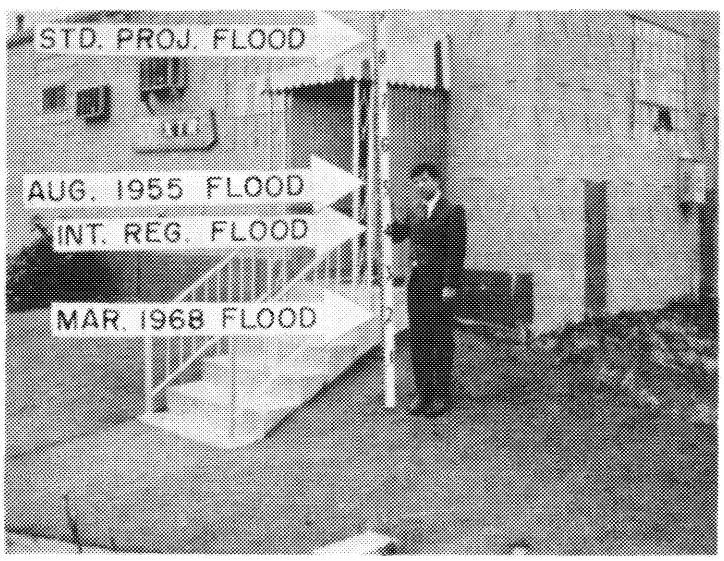
Crown Street, Central Falls, R.I.
March 19, 1968, 12:30 p.m.

Relative Flood Heights
(taken at house on left of top photo)

Figure 6

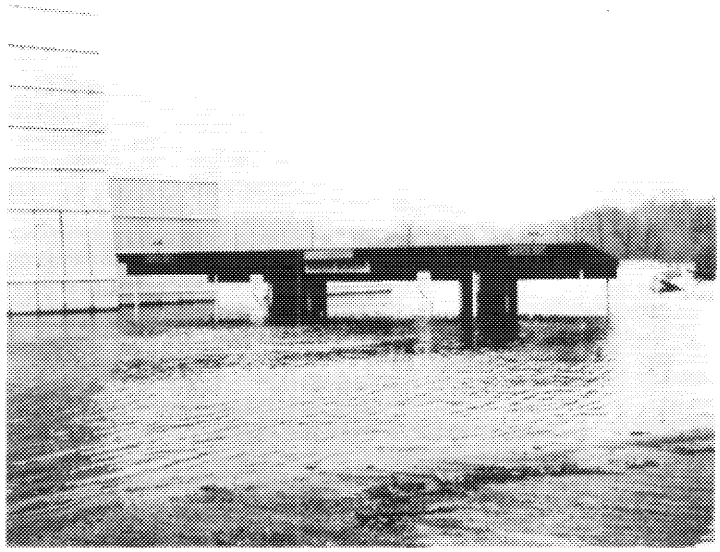


Radio Station, Cumberland, R.I.
March 19, 1968, 1:15 p.m.

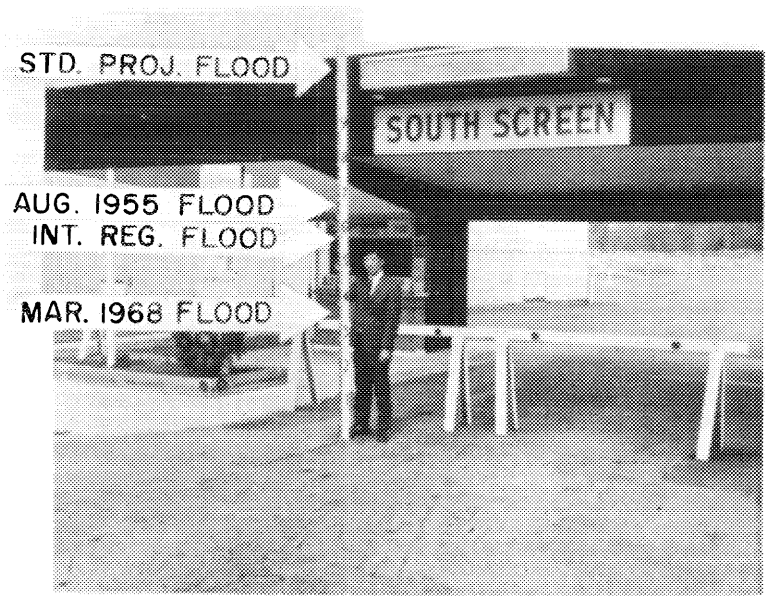


Relative Flood Heights

Figure 7

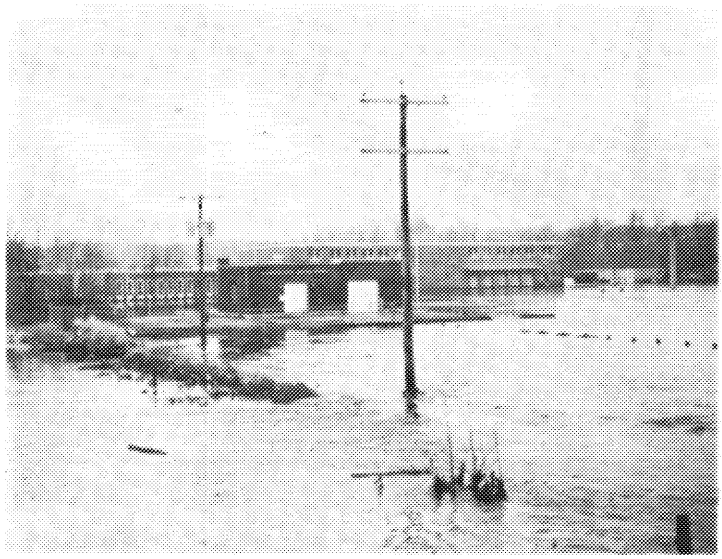


Lonsdale Drive-In, Lincoln, R.I.
March 19, 1968, 1:30 p.m.

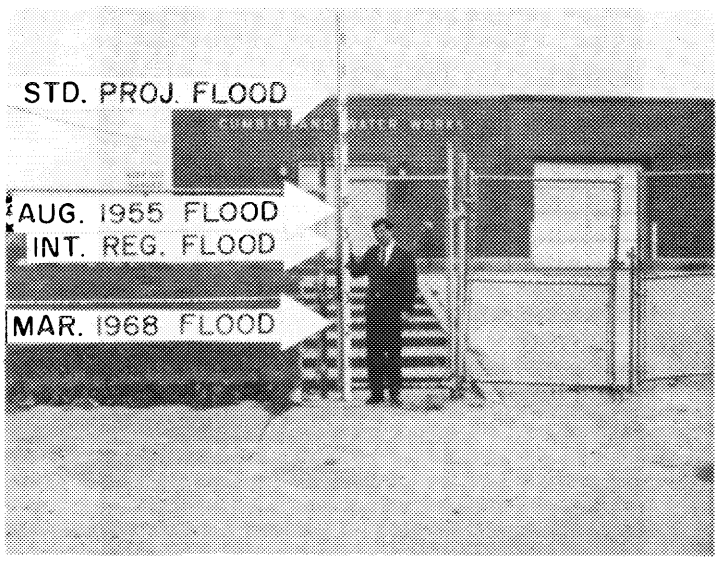


Relative Flood Heights

Figure 8

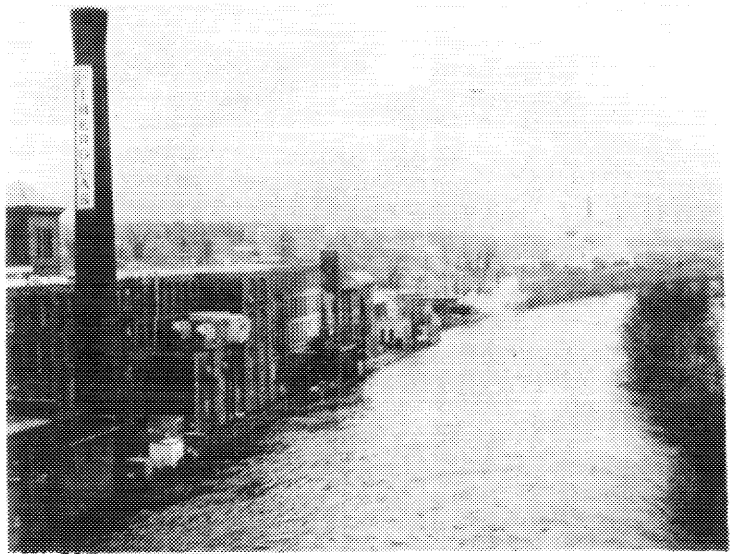


Cumberland Water Works, Cumberland, R.I.
March 19, 1968, 3:00 p.m.

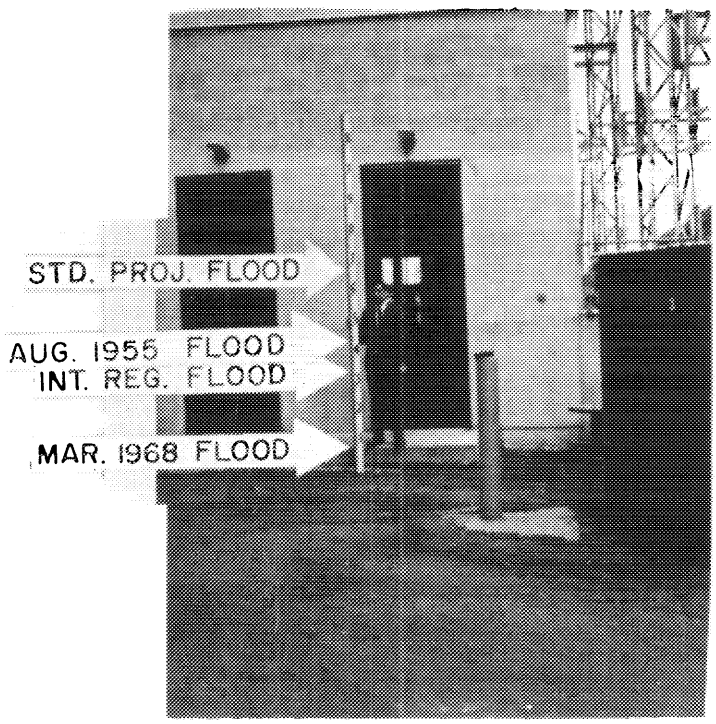


Relative Flood Heights

Figure 9



Owens-Corning Fiberglas Co., Cumberland, R.I.
March 19, 1968, 3:30 p.m.



Relative Flood Heights
(taken in front of power plant
in center of top photo)

Figure 10

GLOSSARY OF TERMS

Flood. An overflow of lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river or stream or an ocean, lake, or other body of standing water.

Normally a "flood" is considered as any temporary rise in stream flow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased stream flow, and other problems.

Flood Crest. The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Peak. The maximum instantaneous discharge of a flood at a given location. It usually occurs at or near the time of the flood crest.

Flood Plain. The relatively flat area or lowlands adjoining the channel of a river, stream or watercourse or ocean, lake, or other body of standing water, which has been or may be covered by flood water.

Flood Profile. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage. The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Head Loss. The effect of obstructions, such as narrow bridge openings or buildings that limit the area through which water must flow, raising the surface of the water upstream from the obstruction.

Intermediate Regional Flood. A flood having an average frequency of occurrence in the order of once in 100 years although the flood may occur in any year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the "general region of the watershed".

Left Bank. The bank on the left side of a river, stream, or watercourse, looking downstream.

Low Steel (or Underclearance). See "Underclearance".

Right Bank. The bank on the right side of a river, stream or watercourse, looking downstream.

Standard Project Flood. The flood that may be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. Peak discharges for these floods are generally about 40% to 60% of the Probable Maximum Floods for the same basins. Such floods, as used by the Corps of Engineers, are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

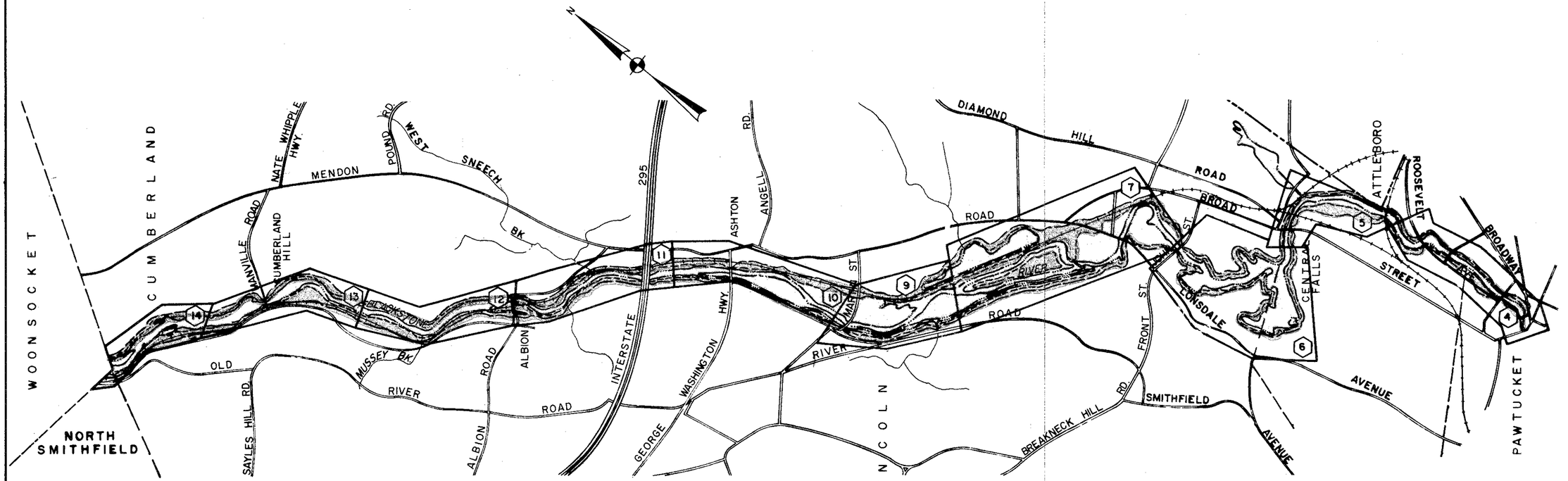
Underclearance. The lowest point of a bridge or other structure over or across a river, stream, or watercourse that limits the opening through which water flows. This is referred to as "low steel" in some regions.

AUTHORITY, ACKNOWLEDGEMENTS AND DATA INTERPRETATION

This report has been prepared in accordance with the authority granted by Section 206 of the Flood Control Act of 1960 (Public Law 86-645).

The cooperation of the towns of Cumberland and Lincoln and the cities of Central Falls and Pawtucket in providing available maps and flood information necessary in the preparation of this study is appreciated. The Blackstone Sewer Authority is also commended for making their aerial photogrammetry available for use in this study.

This report was prepared for the U. S. Army, Corps of Engineers by Fenton G. Keyes Associates, Architect-Engineers, Providence, Rhode Island. The New England Division of the Corps of Engineers will provide limited technical assistance in application of data presented herein, and will provide other available data for flood plain management.



LEGEND

NORMAL FLOW
INTERMEDIATE REGIONAL FLOOD
STANDARD PROJECT FLOOD

(10) - PLATE NUMBERS

SCALE IN FEET
2000' 0 2000' 4000'

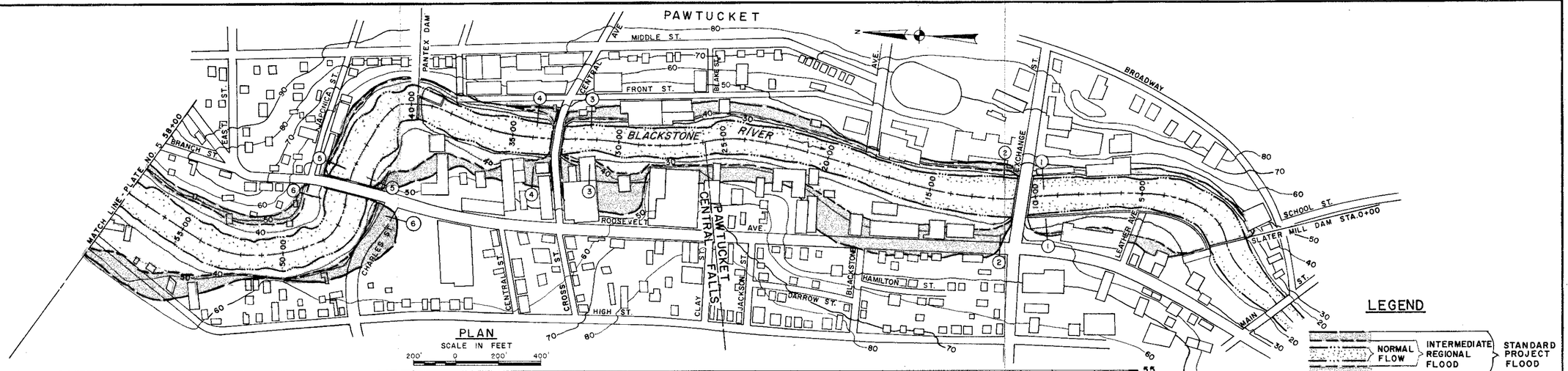
FLOOD PLAIN INFORMATION
BLACKSTONE RIVER
CUMBERLAND, LINCOLN,
CENTRAL FALLS & PAWTUCKET, R.I.
INDEX MAP

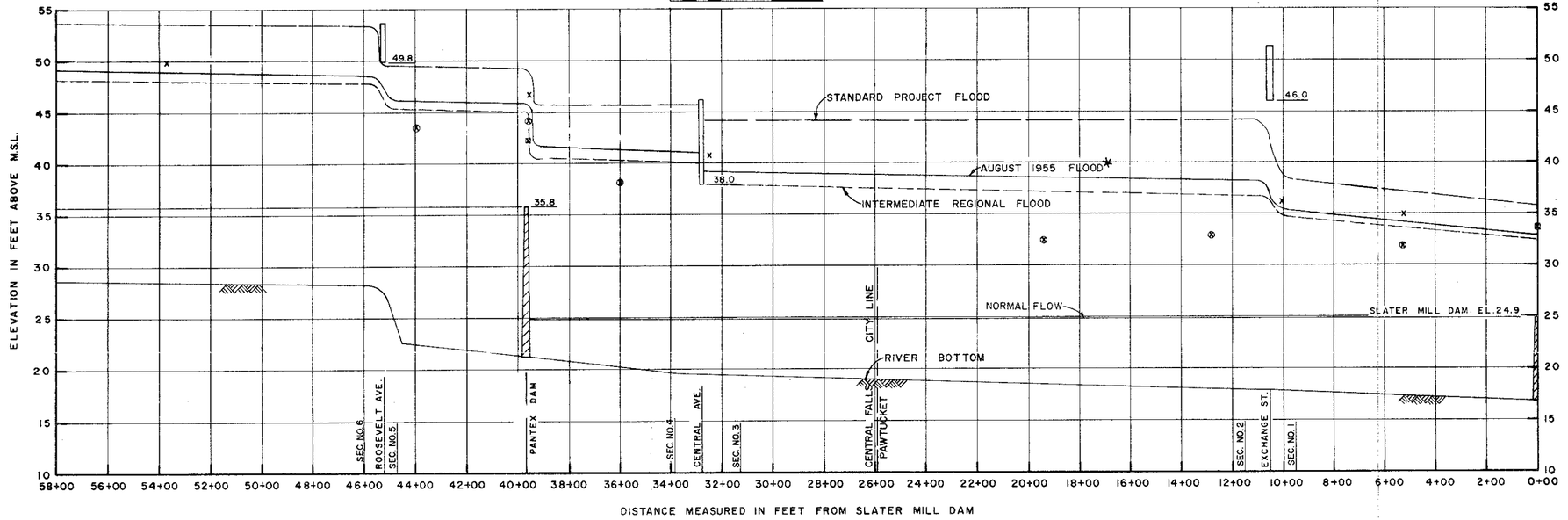
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO.3

CORPS OF ENGINEERS

U.S. ARMY





LEGEND

NORMAL FLOW | INTERMEDIATE REGIONAL FLOOD | STANDARD PROJECT FLOOD

(2) RIVER CROSS-SECTION

HIGHWAY BRIDGE

DAM

× OBSERVED 1955 HIGH WATER MARKS

⊗ OBSERVED 1968 HIGH WATER MARKS

■ OBSERVED MARCH 1936 HIGH WATER MARKS

✱ MODIFIED BY WEST HILL FLOOD CONTROL RESERVOIR

NOTES

1. LIMITS OF OVERFLOW INDICATED MAY VARY SOME FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.
2. ELEVATIONS REFER TO MEAN SEA LEVEL DATUM. CONTOUR INTERVAL EQUALS TEN FEET.
3. TOPOGRAPHY IS BASED ON U.S.G.S. MAPS AND 200 SCALE PHOTOGRAMMETRY (APRIL 1968).

PREPARED BY
FENTON G. KEYES ASSOCIATES
CONSULTING ARCHITECT-ENGINEERS
PROVIDENCE, R.I. WALTHAM, MASS. NASHUA, N.H. PUTNAM, CONN.

FLOOD PLAIN INFORMATION

BLACKSTONE RIVER

CUMBERLAND, LINCOLN, CENTRAL FALLS, & PAWTUCKET, R.I.

PLAN AND PROFILE

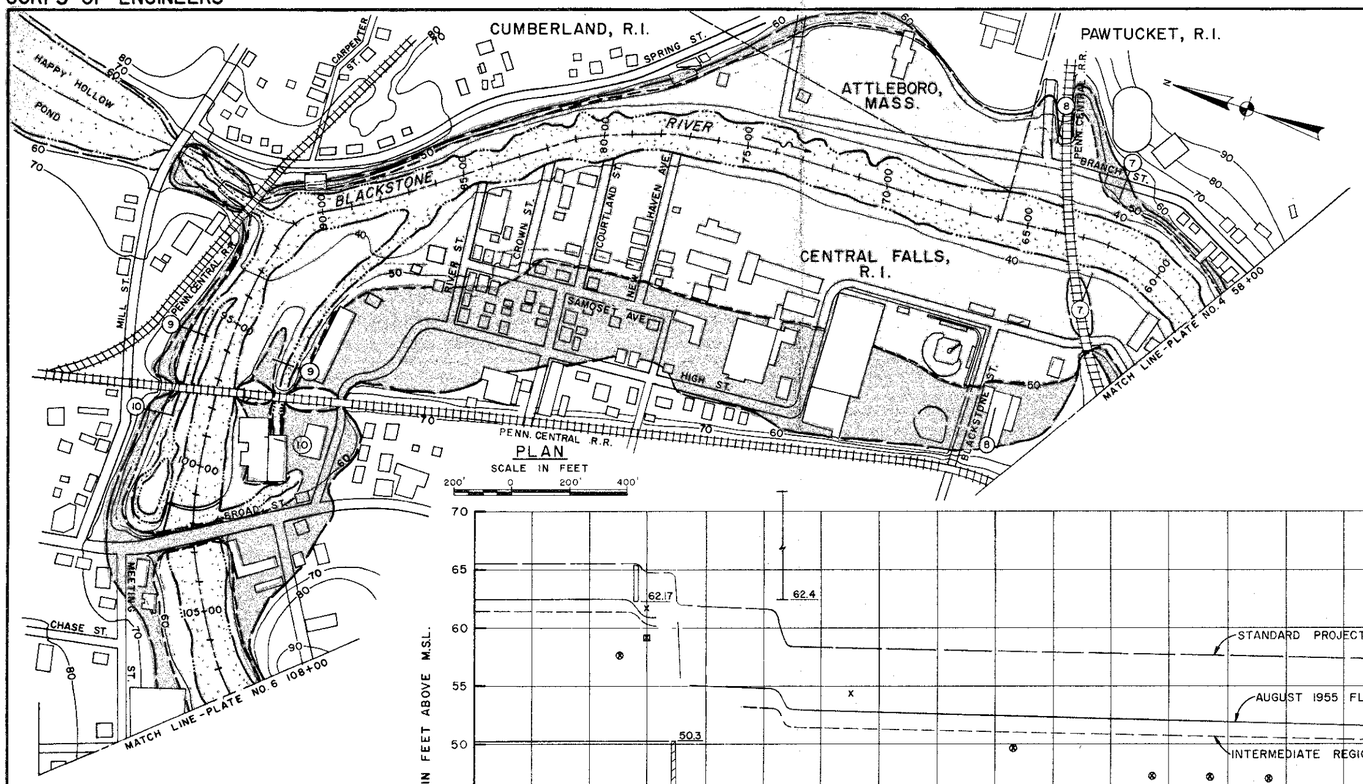
STA. 0+00 TO 58+00

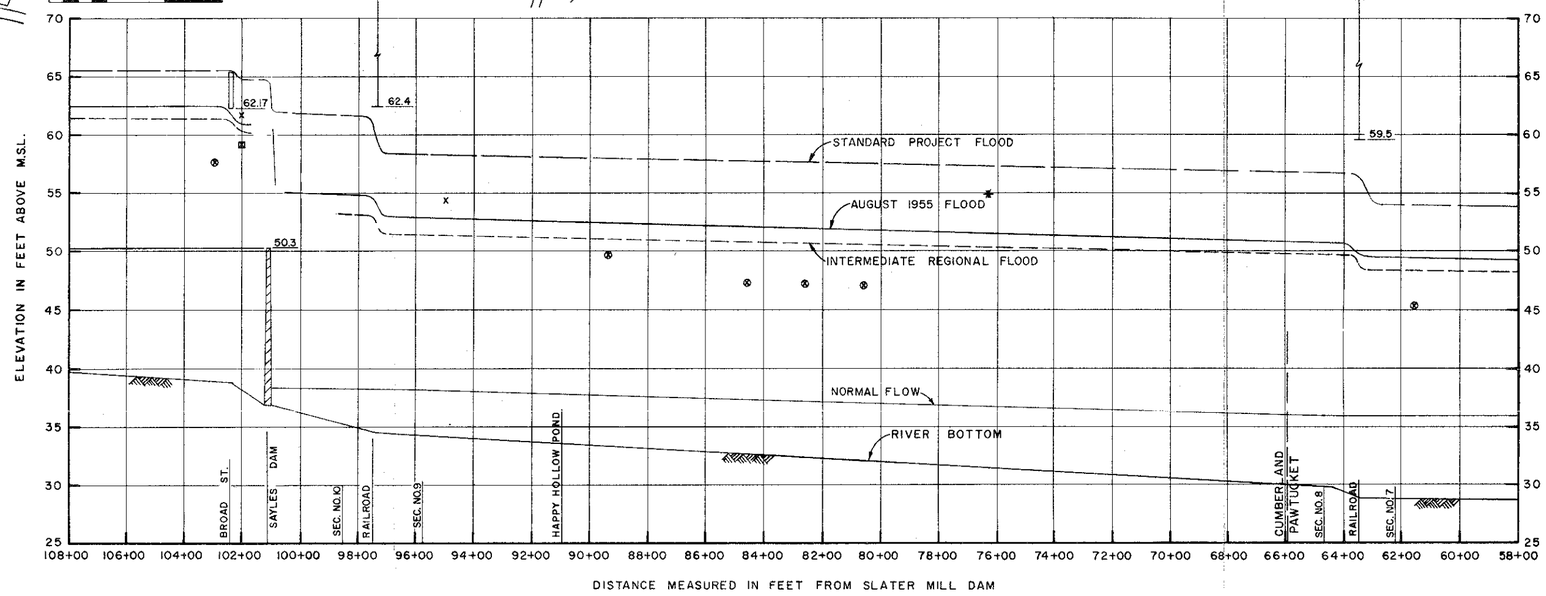
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 4

CORPS OF ENGINEERS

U.S. ARMY





LEGEND

NORMAL FLOW / INTERMEDIATE REGIONAL FLOOD / STANDARD PROJECT FLOOD

② RIVER CROSS-SECTION

RAILROAD BRIDGE

HIGHWAY BRIDGE

DAM

x OBSERVED 1955 HIGH WATER MARKS

⊗ OBSERVED 1968 HIGH WATER MARKS

▣ OBSERVED MARCH 1936 HIGH WATER MARKS

* MODIFIED BY WEST HILL FLOOD CONTROL RESERVOIR

NOTES

1. LIMITS OF OVERFLOW INDICATED MAY VARY SOME FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.
2. ELEVATIONS REFER TO MEAN SEA LEVEL DATUM. CONTOUR INTERVAL EQUALS TEN FEET.
3. TOPOGRAPHY IS BASED ON U.S.G.S. MAPS AND 200 SCALE PHOTOGRAMMETRY (APRIL 1968).

PREPARED BY
FENTON G. KEYES ASSOCIATES
CONSULTING ARCHITECT-ENGINEERS
PROVIDENCE, R.I. WALTHAM, MASS. NASHUA, N.H. PUTNAM, CONN.

FLOOD PLAIN INFORMATION

BLACKSTONE RIVER

CUMBERLAND, LINCOLN, CENTRAL FALLS, & PAWTUCKET, R.I.

PLAN AND PROFILE

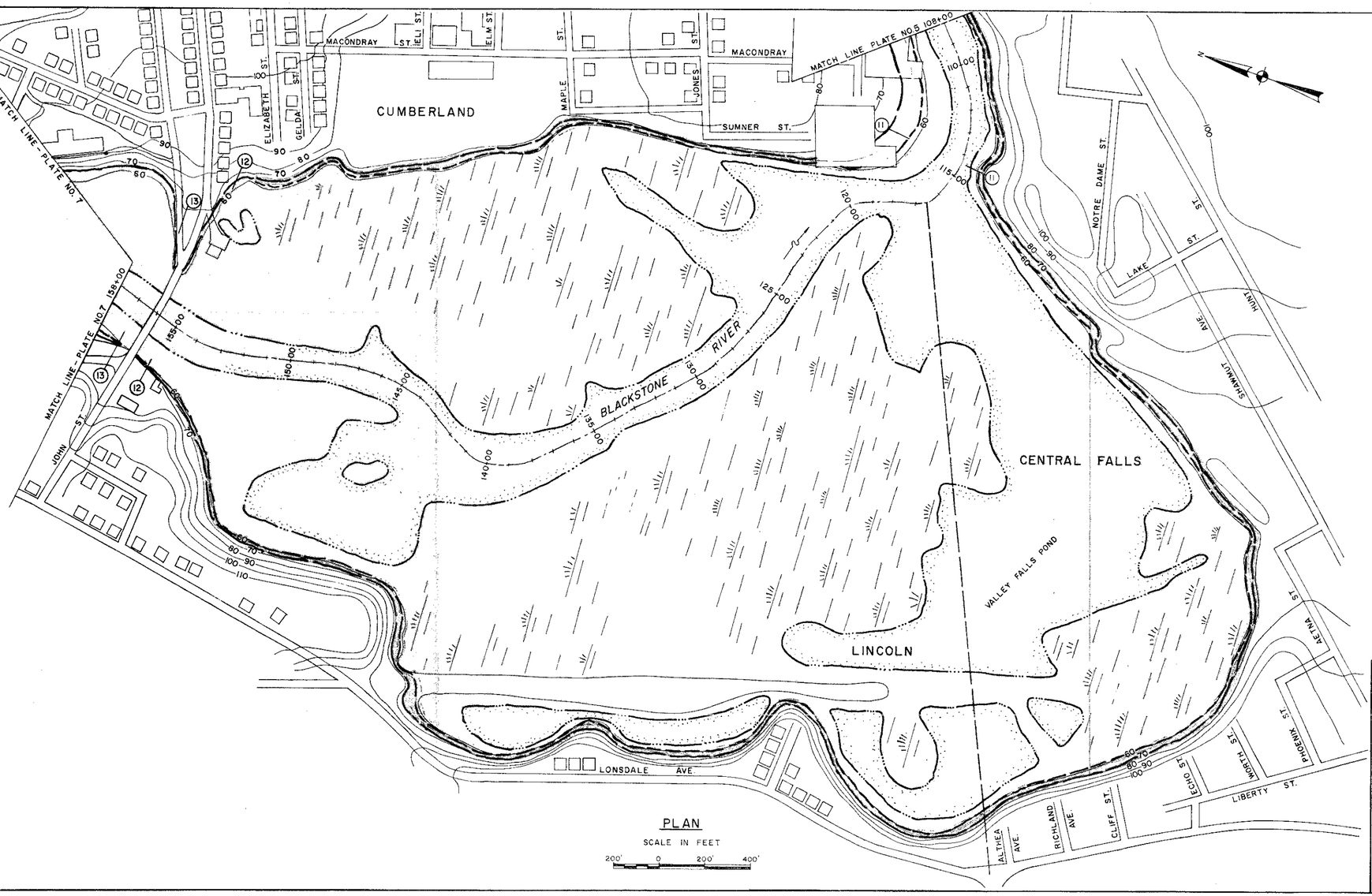
STA. 58+00 TO 108+00

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 5

CORPS OF ENGINEERS

U.S. ARMY



PLAN

SCALE IN FEET

200' 0 200' 400'

LEGEND

NORMAL FLOW | INTERMEDIATE REGIONAL FLOOD | STANDARD PROJECT FLOOD

(2) RIVER CROSS-SECTION

NOTES

1. LIMITS OF OVERFLOW INDICATED MAY VARY SOME FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.
2. ELEVATIONS REFER TO MEAN SEA LEVEL DATUM. CONTOUR INTERVAL EQUALS TEN FEET.
3. TOPOGRAPHY IS BASED ON U.S.G.S. MAPS AND 200 SCALE PHOTOGRAMMETRY (APRIL 1968).

PREPARED BY
FENTON G. KEYES ASSOCIATES
CONSULTING ARCHITECT-ENGINEERS
PROVIDENCE, R.I. WALTHAM, MASS. NASHUA, N.H. PUTNAM, CONN.

FLOOD PLAIN INFORMATION
BLACKSTONE RIVER
CUMBERLAND, LINCOLN, CENTRAL FALLS, & PAWTUCKET, R.I.

PLAN

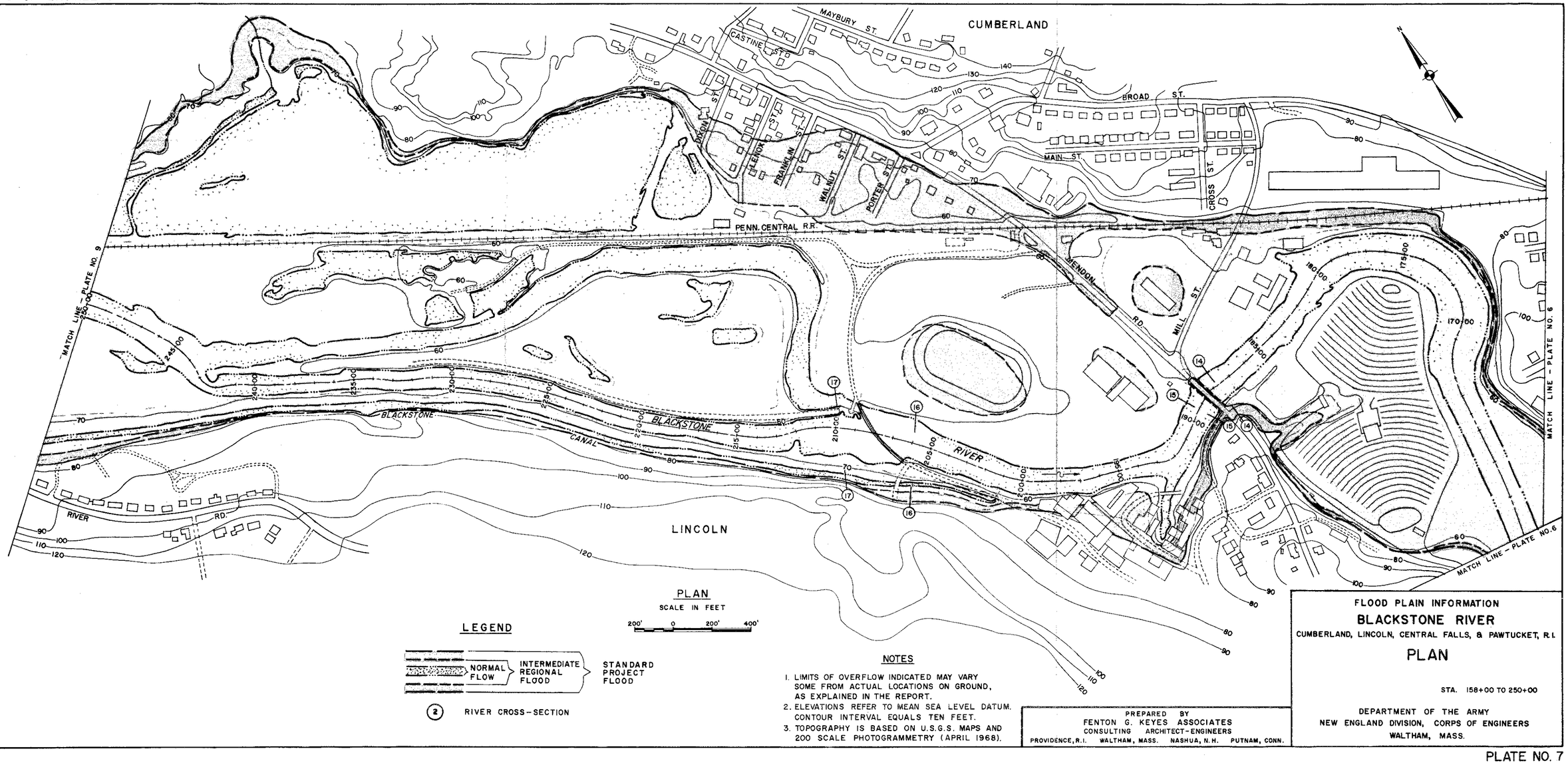
STA. 108+00 TO 158+00

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 6

CORPS OF ENGINEERS

U.S. ARMY



PLAN

SCALE IN FEET

200' 0 200' 400'

LEGEND

NORMAL FLOW

INTERMEDIATE REGIONAL FLOOD

STANDARD PROJECT FLOOD

(2) RIVER CROSS-SECTION

NOTES

1. LIMITS OF OVERFLOW INDICATED MAY VARY SOME FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.
2. ELEVATIONS REFER TO MEAN SEA LEVEL DATUM. CONTOUR INTERVAL EQUALS TEN FEET.
3. TOPOGRAPHY IS BASED ON U.S.G.S. MAPS AND 200 SCALE PHOTOGRAMMETRY (APRIL 1968).

PREPARED BY
FENTON G. KEYES ASSOCIATES
CONSULTING ARCHITECT-ENGINEERS
PROVIDENCE, R.I. WALTHAM, MASS. NASHUA, N.H. PUTNAM, CONN.

FLOOD PLAIN INFORMATION

BLACKSTONE RIVER

CUMBERLAND, LINCOLN, CENTRAL FALLS, & PAWTUCKET, R.I.

PLAN

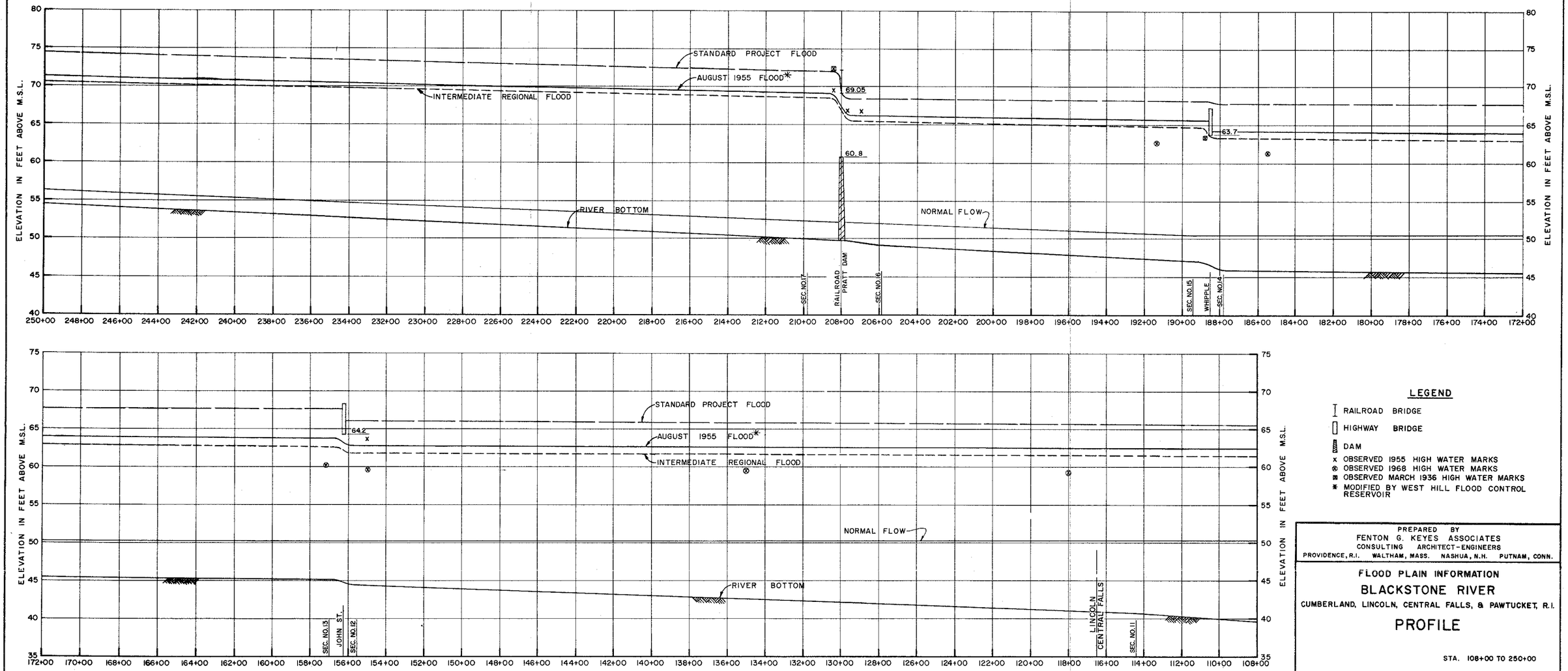
STA. 158+00 TO 250+00

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 7

CORPS OF ENGINEERS

U.S. ARMY



LEGEND

- RAILROAD BRIDGE
- HIGHWAY BRIDGE
- DAM
- x OBSERVED 1955 HIGH WATER MARKS
- ⊗ OBSERVED 1968 HIGH WATER MARKS
- ⊠ OBSERVED MARCH 1936 HIGH WATER MARKS
- * MODIFIED BY WEST HILL FLOOD CONTROL RESERVOIR

PREPARED BY
FENTON G. KEYES ASSOCIATES
CONSULTING ARCHITECT-ENGINEERS
PROVIDENCE, R.I. WALTHAM, MASS. NASHUA, N.H. PUTNAM, CONN.

FLOOD PLAIN INFORMATION

BLACKSTONE RIVER

CUMBERLAND, LINCOLN, CENTRAL FALLS, & PAWTUCKET, R.I.

PROFILE

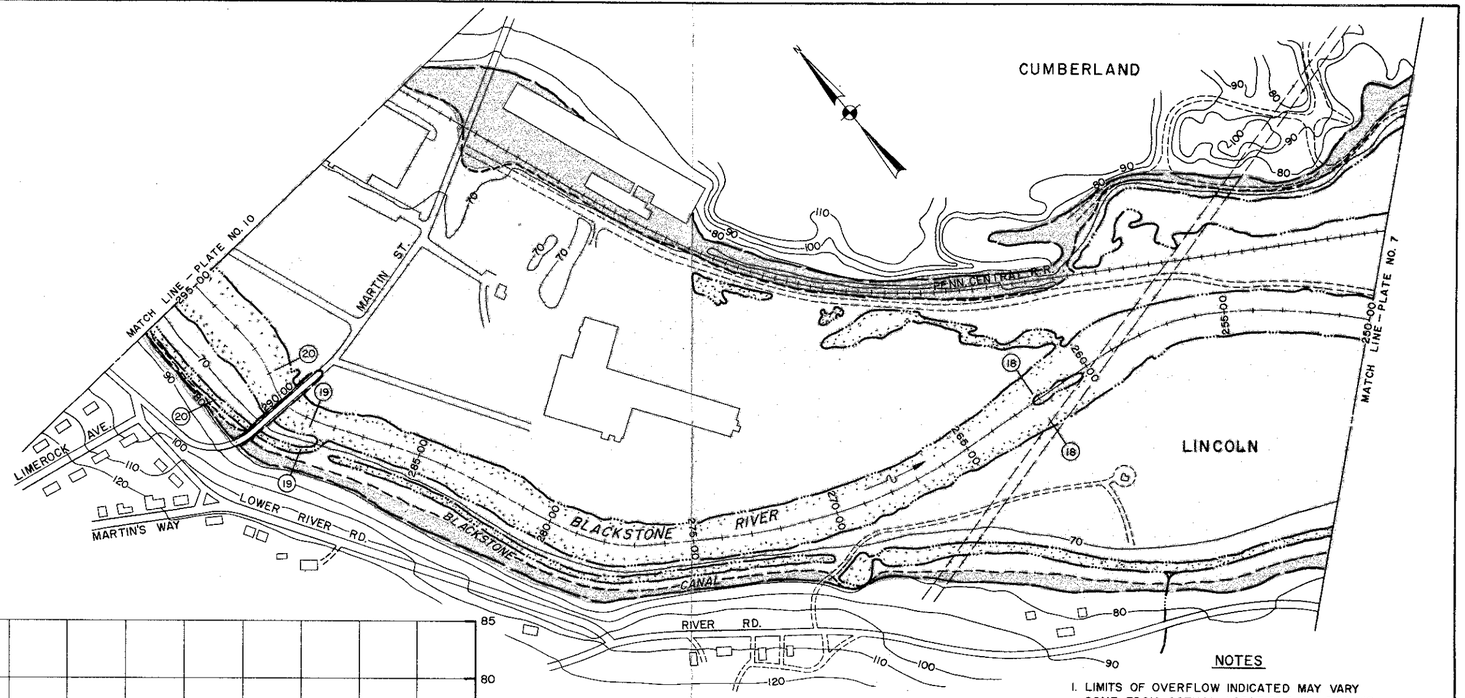
STA. 108+00 TO 250+00

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 8

CORPS OF ENGINEERS

U.S. ARMY



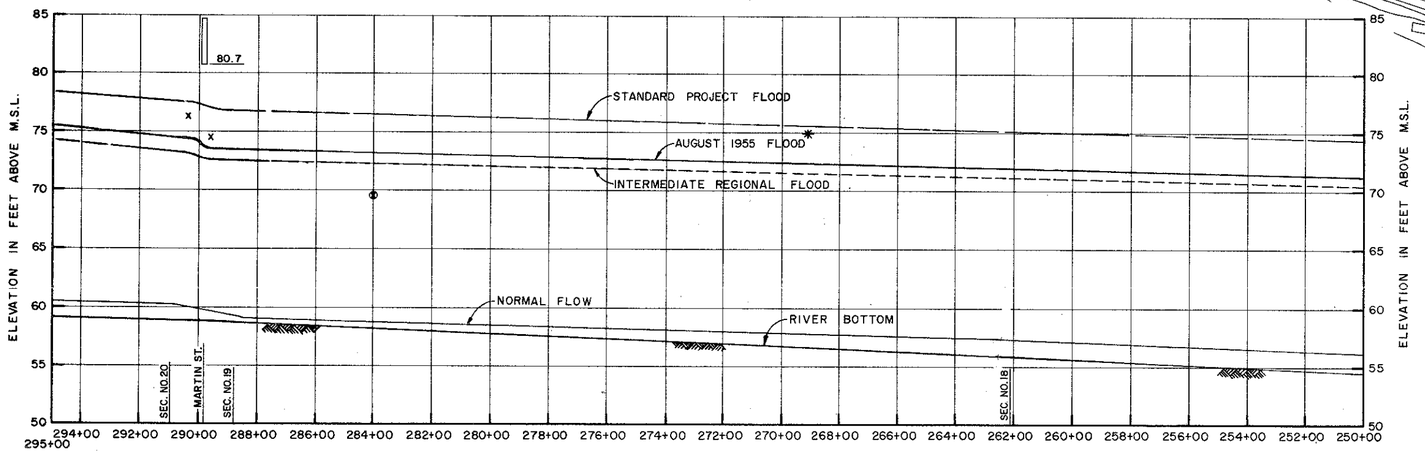
PLAN

SCALE IN FEET

200' 0 200' 400'

NOTES

1. LIMITS OF OVERFLOW INDICATED MAY VARY SOME FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.
2. ELEVATIONS REFER TO MEAN SEA LEVEL DATUM. CONTOUR INTERVAL EQUALS TEN FEET.
3. TOPOGRAPHY IS BASED ON U.S.G.S. MAPS AND 200 SCALE PHOTOGRAMMETRY (APRIL 1968).



DISTANCE MEASURED IN FEET FROM SLATER MILL DAM

LEGEND

- HIGHWAY BRIDGE
- x OBSERVED 1955 HIGH WATER MARKS
- ⊗ OBSERVED 1968 HIGH WATER MARKS
- ⊠ OBSERVED MARCH 1936 HIGH WATER MARKS
- ✱ MODIFIED BY WEST HILL FLOOD CONTROL RESERVOIR

NORMAL FLOW | INTERMEDIATE REGION FLOOD | STANDARD PROJECT FLOOD

(2) RIVER CROSS-SECTION

PREPARED BY
FENTON G. KEYES ASSOCIATES
CONSULTING ARCHITECT-ENGINEERS
PROVIDENCE, R.I. WALTHAM, MASS. NASHUA, N.H. PUTNAM, CONN.

FLOOD PLAIN INFORMATION

BLACKSTONE RIVER

CUMBERLAND, LINCOLN, CENTRAL FALLS, & PAWTUCKET, R.I.

PLAN AND PROFILE

STA. 250+00 TO 295+00

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 9

CORPS OF ENGINEERS

U.S. ARMY

LEGEND

NORMAL FLOW / INTERMEDIATE REGIONAL FLOOD / STANDARD PROJECT FLOOD

HIGHWAY BRIDGE

DAM (2) RIVER CROSS-SECTION

X OBSERVED 1955 HIGH WATER MARKS

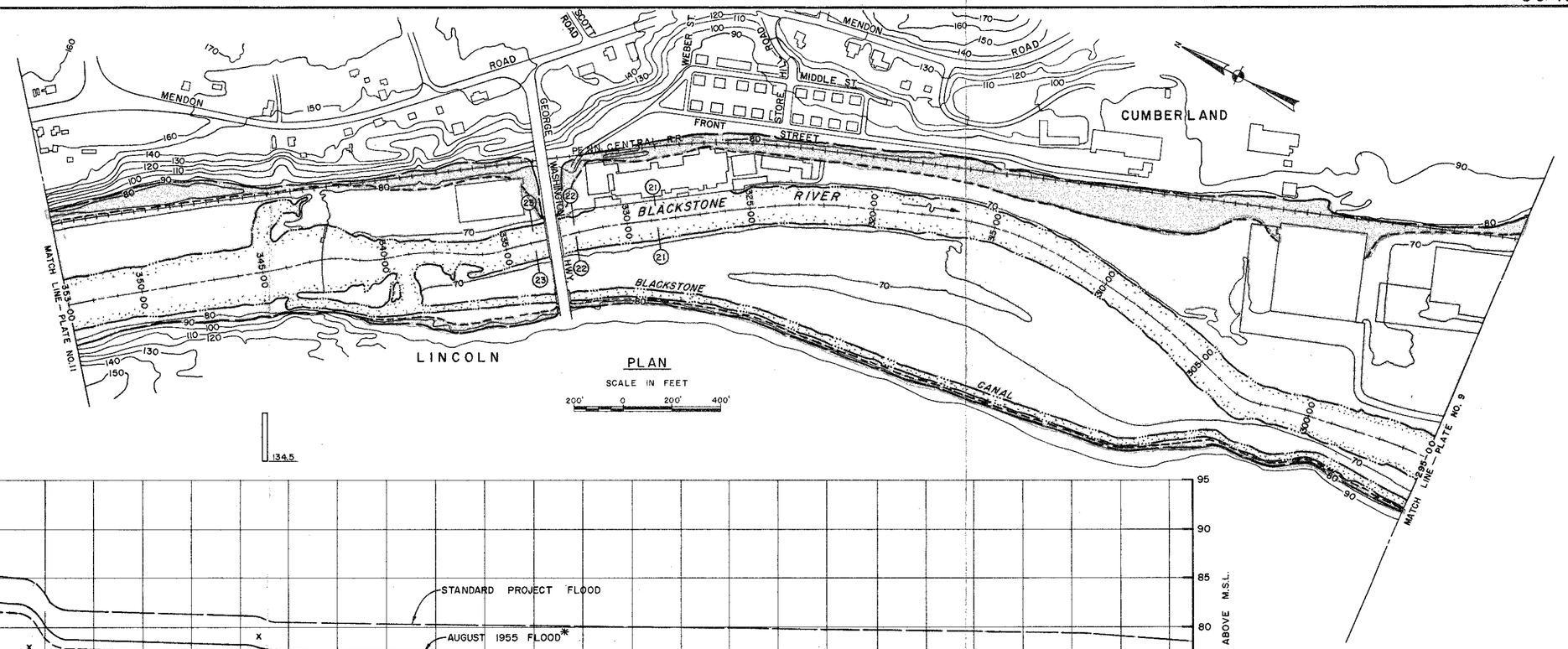
⊗ OBSERVED 1968 HIGH WATER MARKS

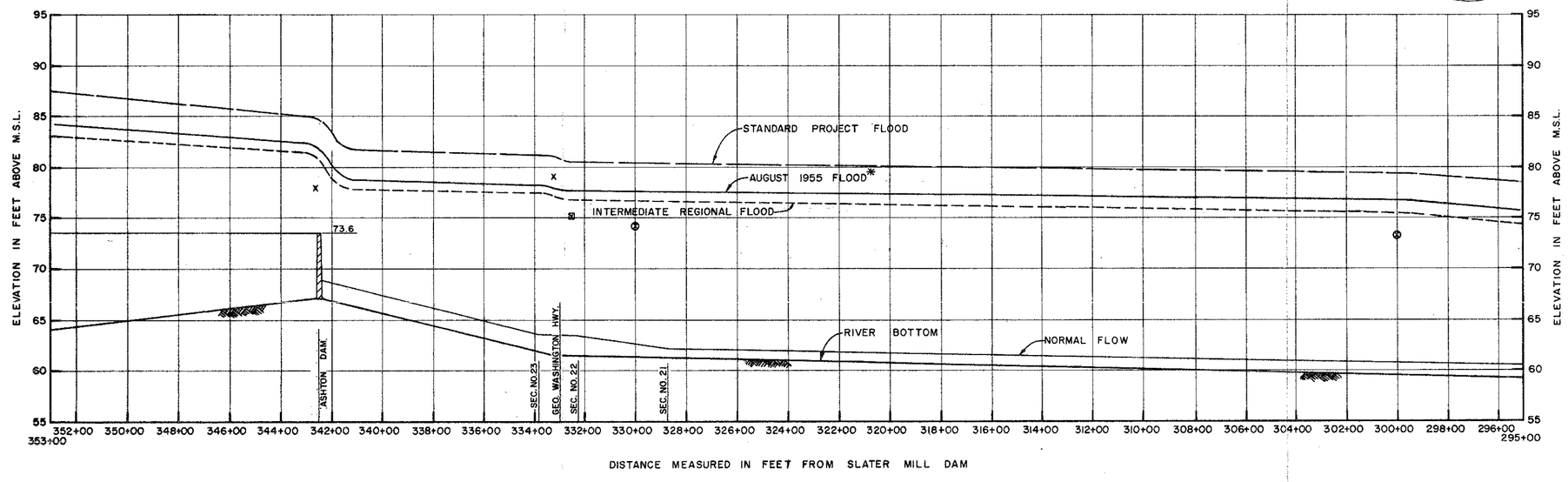
▩ OBSERVED MARCH 1936 HIGH WATER MARKS

* MODIFIED BY WEST HILL FLOOD CONTROL RESERVOIR

NOTES

1. LIMITS OF OVERFLOW INDICATED MAY VARY SOME FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.
2. ELEVATIONS REFER TO MEAN SEA LEVEL DATUM. CONTOUR INTERVAL EQUALS TEN FEET.
3. TOPOGRAPHY IS BASED ON U.S.G.S. MAPS AND 200 SCALE PHOTOGRAMMETRY (APRIL 1968).





PREPARED BY
FENTON G. KEYES ASSOCIATES
CONSULTING ARCHITECT-ENGINEERS
PROVIDENCE, R.I. WALTHAM, MASS. NASHUA, N.H. PUTNAM, CONN.

FLOOD PLAIN INFORMATION

BLACKSTONE RIVER

CUMBERLAND, LINCOLN, CENTRAL FALLS, & PAWTUCKET, R.I.

PLAN AND PROFILE

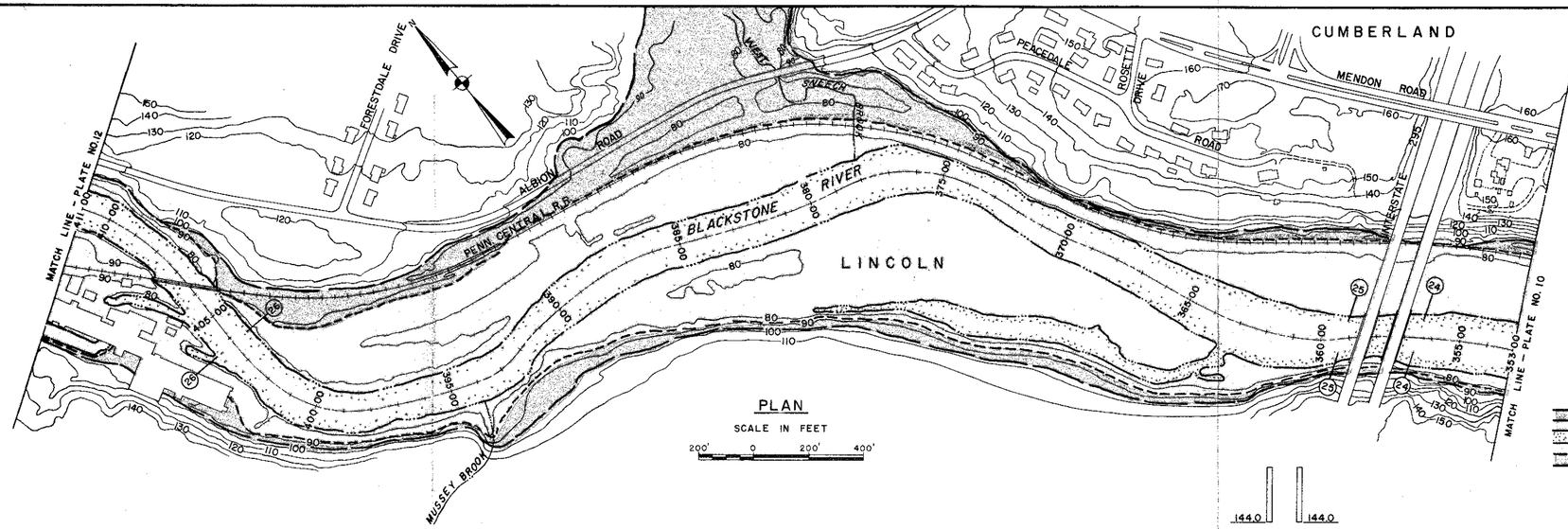
STA. 295+00 TO 353+00

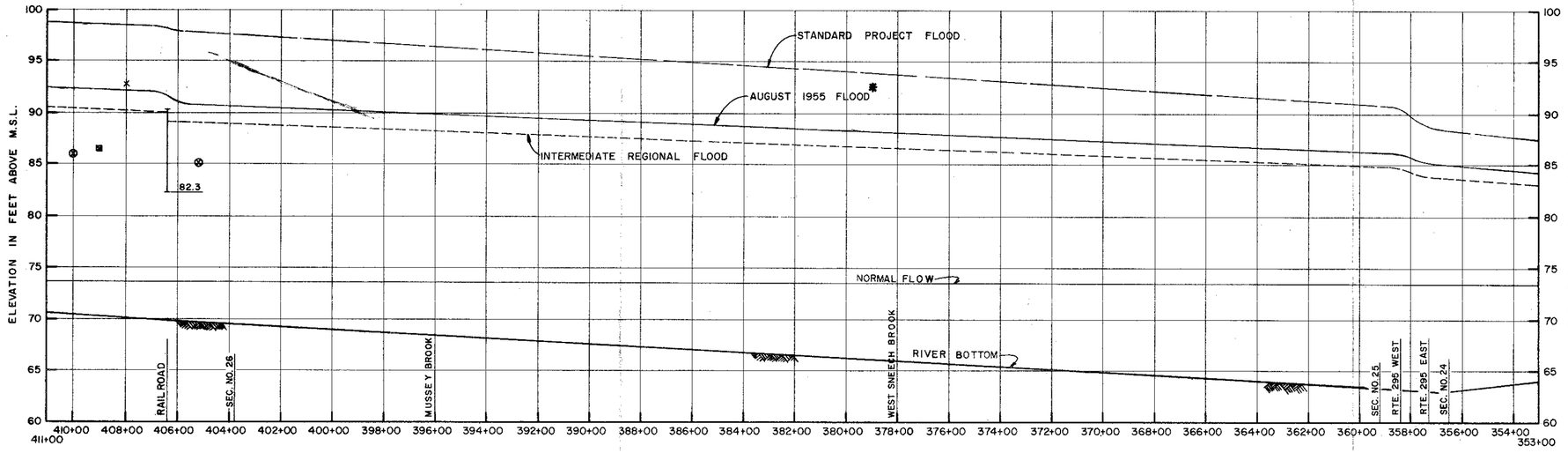
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 10

CORPS OF ENGINEERS

U.S. ARMY





LEGEND

NORMAL FLOW / INTERMEDIATE REGIONAL FLOOD / STANDARD PROJECT FLOOD

(2) RIVER CROSS-SECTION

I RAILROAD BRIDGE

HIGHWAY BRIDGE

X OBSERVED 1955 HIGH WATER MARKS

⊗ OBSERVED 1968 HIGH WATER MARKS

⊠ OBSERVED MARCH 1936 HIGH WATER MARKS

* MODIFIED BY WEST HILL FLOOD CONTROL RESERVOIR

NOTES

1. LIMITS OF OVERFLOW INDICATED MAY VARY SOME FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.
2. ELEVATIONS REFER TO MEAN SEA LEVEL DATUM. CONTOUR INTERVAL EQUALS TEN FEET.
3. TOPOGRAPHY IS BASED ON U.S.G.S. MAPS AND 200 SCALE PHOTOGRAMMETRY (APRIL 1968).

PREPARED BY
FENTON G. KEYES ASSOCIATES
CONSULTING ARCHITECT – ENGINEERS
PROVIDENCE, R.I. WALTHAM, MASS. NASHUA, N.H. PUTNAM, CONN.

FLOOD PLAIN INFORMATION

BLACKSTONE RIVER

CUMBERLAND, LINCOLN, CENTRAL FALLS, & PAWTUCKET, R.I.

PLAN AND PROFILE

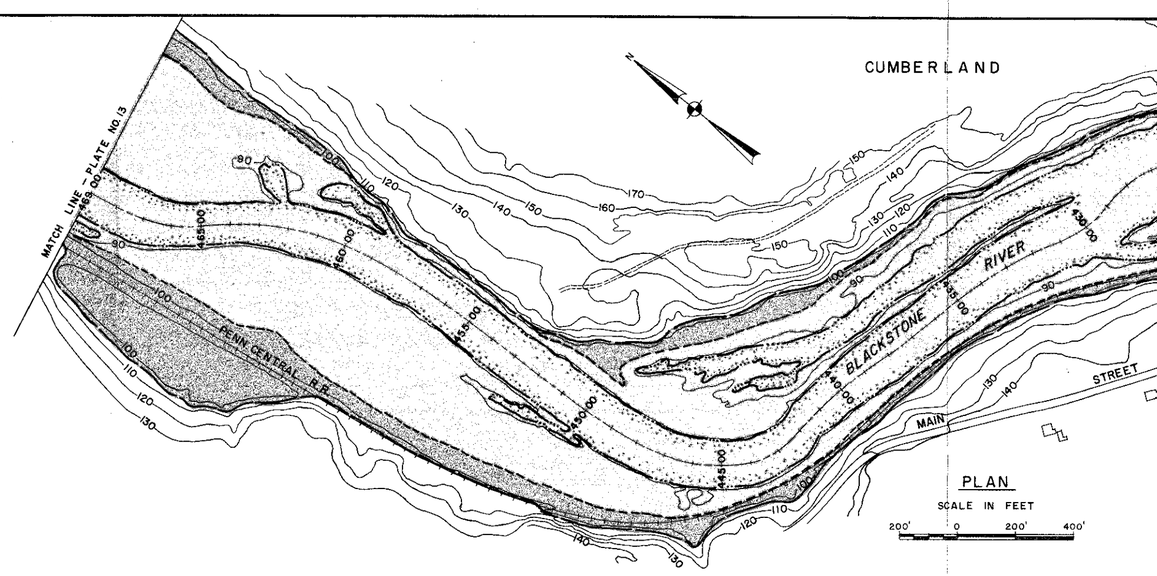
STA. 353+00 TO 411+00

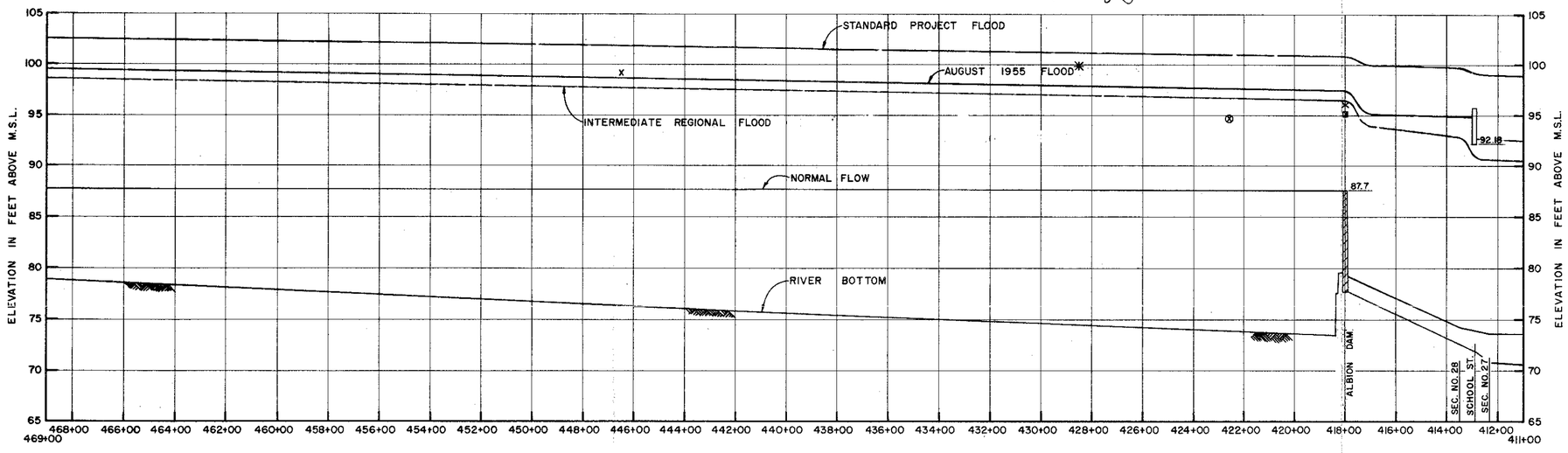
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 11

CORPS OF ENGINEERS

U.S. ARMY





LEGEND

NORMAL FLOW → INTERMEDIATE REGIONAL FLOOD → STANDARD PROJECT FLOOD

(2) RIVER CROSS-SECTION

HIGHWAY BRIDGE

DAM

X OBSERVED 1955 HIGH WATER MARKS

⊗ OBSERVED 1968 HIGH WATER MARKS

⊠ OBSERVED MARCH 1936 HIGH WATER MARKS

* MODIFIED BY WEST HILL FLOOD CONTROL RESERVOIR

NOTES

1. LIMITS OF OVERFLOW INDICATED MAY VARY SOME FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.
2. ELEVATIONS REFER TO MEAN SEA LEVEL DATUM. CONTOUR INTERVAL EQUALS TEN FEET.
3. TOPOGRAPHY IS BASED ON U.S.G.S. MAPS AND 200 SCALE PHOTOGRAMMETRY (APRIL 1968).

PREPARED BY
FENTON G. KEYES ASSOCIATES
CONSULTING ARCHITECT - ENGINEERS
PROVIDENCE, R.I. WALTHAM, MASS. NASHUA, N.H. PUTNAM, CONN.

FLOOD PLAIN INFORMATION

BLACKSTONE RIVER

CUMBERLAND, LINCOLN, CENTRAL FALLS, & PAWTUCKET, R.I.

PLAN AND PROFILE

STA. 411+00 TO 469+00

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 12

CORPS OF ENGINEERS

U.S. ARMY

LEGEND

NORMAL FLOW > INTERMEDIATE REGIONAL FLOOD > STANDARD PROJECT FLOOD

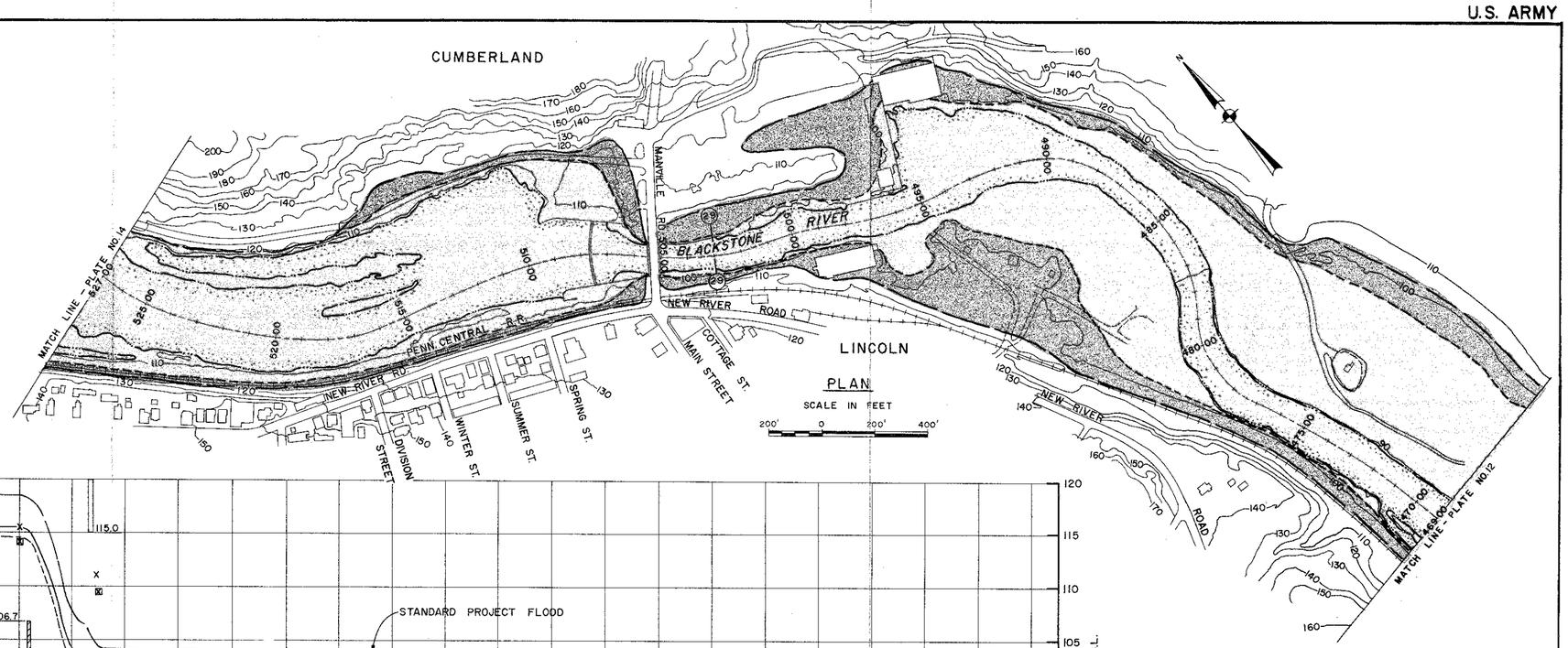
HIGHWAY BRIDGE (2) RIVER CROSS-SECTION

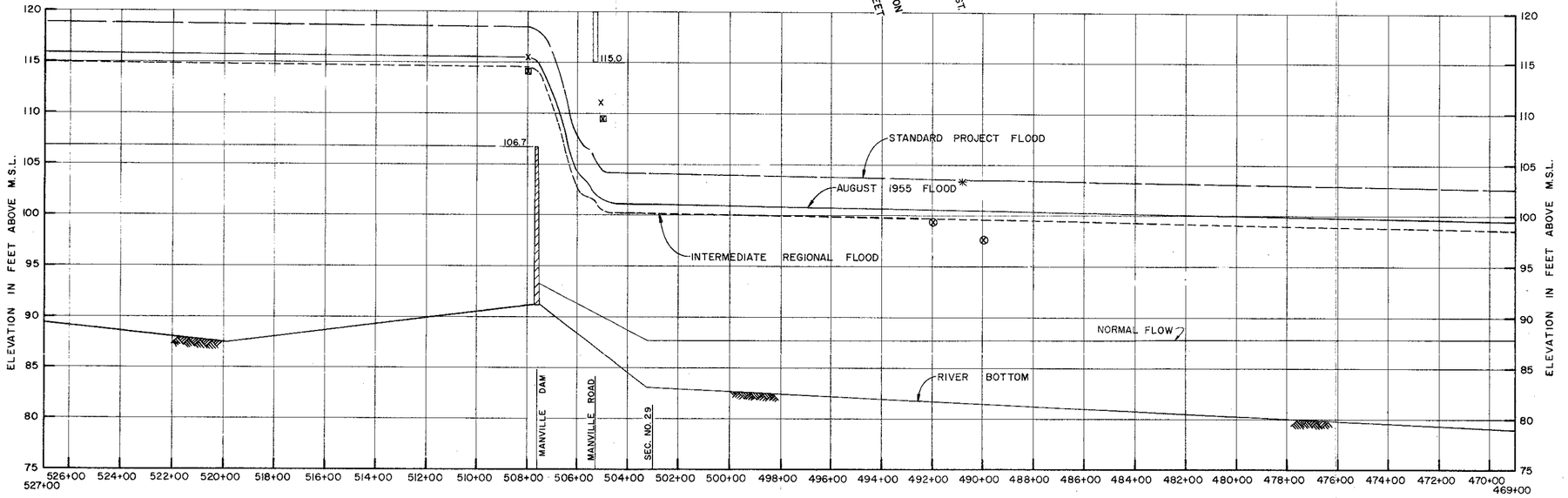
DAM

X OBSERVED 1955 HIGH WATER MARKS
⊗ OBSERVED 1968 HIGH WATER MARKS
⊠ OBSERVED MARCH 1936 HIGH WATER MARKS
* MODIFIED BY WEST HILL FLOOD CONTROL RESERVOIR

NOTES

1. LIMITS OF OVERFLOW INDICATED MAY VARY SOME FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.
2. ELEVATIONS REFER TO MEAN SEA LEVEL DATUM CONTOUR INTERVAL EQUALS TEN FEET.
3. TOPOGRAPHY IS BASED ON U.S.G.S MAPS AND 200 SCALE PHOTOGRAMMETRY (APRIL 1968).





PREPARED BY
FENTON G. KEYES ASSOCIATES
CONSULTING ARCHITECT – ENGINEERS
PROVIDENCE, R.I. WALTHAM, MASS. NASHUA, N.H. PUTNAM, CONN.

FLOOD PLAIN INFORMATION

BLACKSTONE RIVER

CUMBERLAND, LINCOLN, CENTRAL FALLS, & PAWTUCKET, R.I.

PLAN AND PROFILE

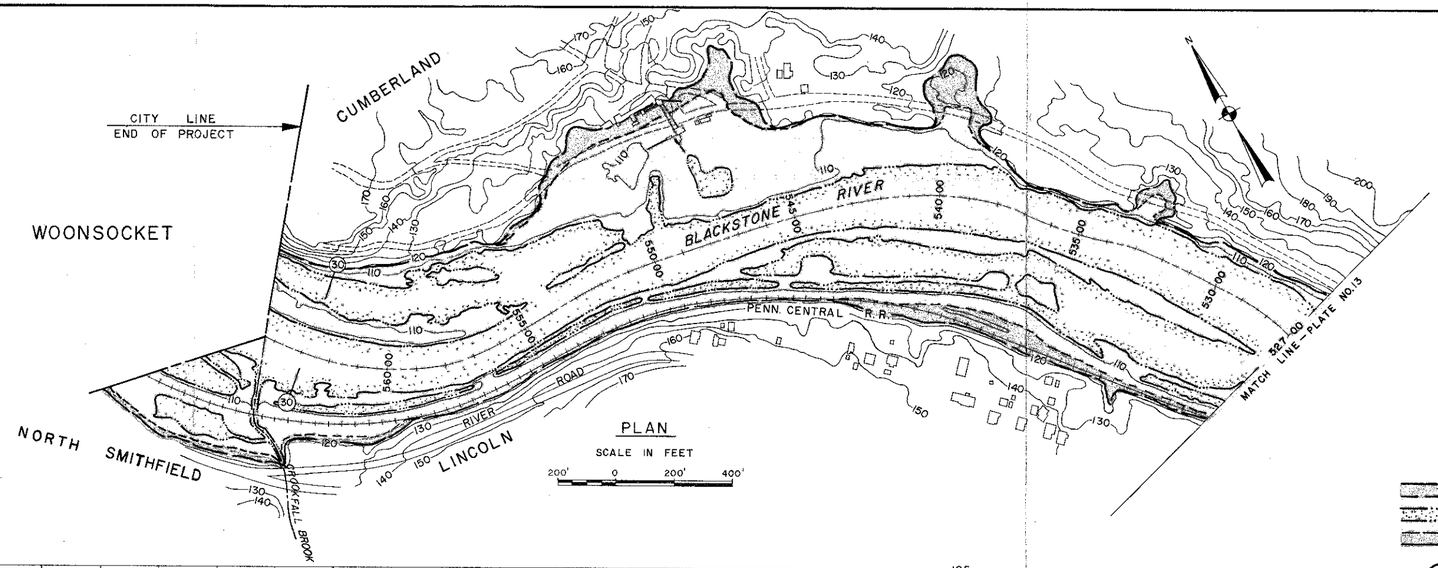
STA. 469+00 TO 527+00

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 13

CORPS OF ENGINEERS

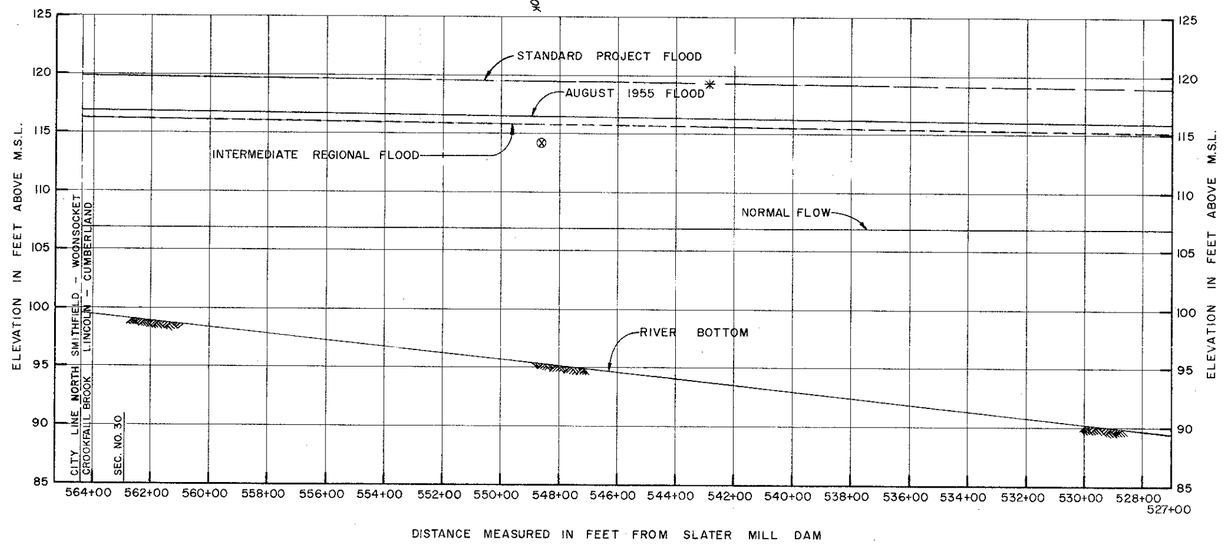
U.S. ARMY



PLAN

SCALE IN FEET

200' 0 200' 400'



LEGEND

NORMAL FLOW | INTERMEDIATE REGIONAL FLOOD | STANDARD PROJECT FLOOD

(2) RIVER CROSS-SECTION

X OBSERVED 1955 HIGH WATER MARKS
⊗ OBSERVED 1968 HIGH WATER MARKS
⊠ OBSERVED MARCH 1936 HIGH WATER MARKS
✱ MODIFIED BY WEST HILL FLOOD CONTROL RESERVOIR

NOTES

1. LIMITS OF OVERFLOW INDICATED MAY VARY SOME FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.
2. ELEVATIONS REFER TO MEAN SEA LEVEL DATUM. CONTOUR INTERVAL EQUALS TEN FEET
3. TOPOGRAPHY IS BASED ON U.S.G.S. MAPS AND 200 SCALE PHOTOGRAMMETRY (APRIL 1968).

PREPARED BY
FENTON G. KEYES ASSOCIATES
CONSULTING ARCHITECT – ENGINEERS
PROVIDENCE, R.I. WALTHAM, MASS. NASHUA, N.H. PUTNAM, CONN.

FLOOD PLAIN INFORMATION

BLACKSTONE RIVER

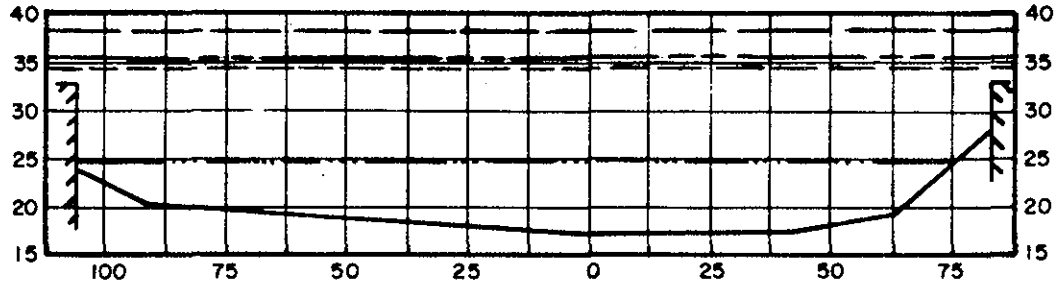
CUMBERLAND, LINCOLN, CENTRAL FALLS, & PAWTUCKET, R.I.

PLAN AND PROFILE

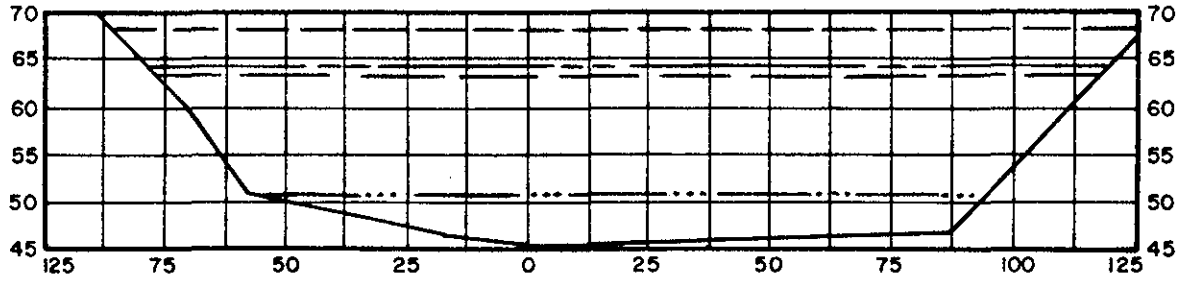
STA. 527+00 TO 564+40

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

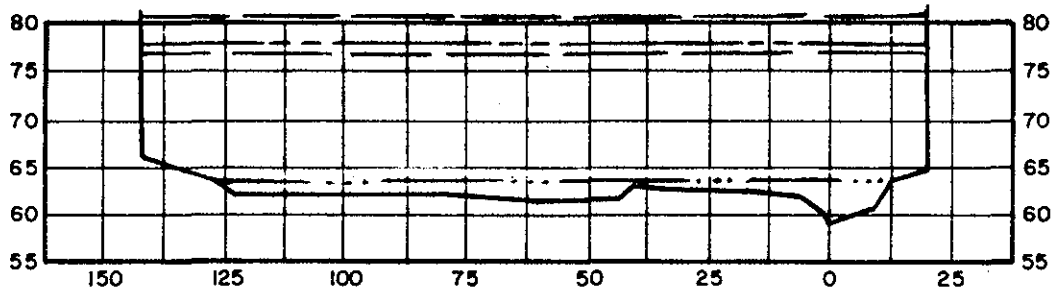
PLATE NO. 14



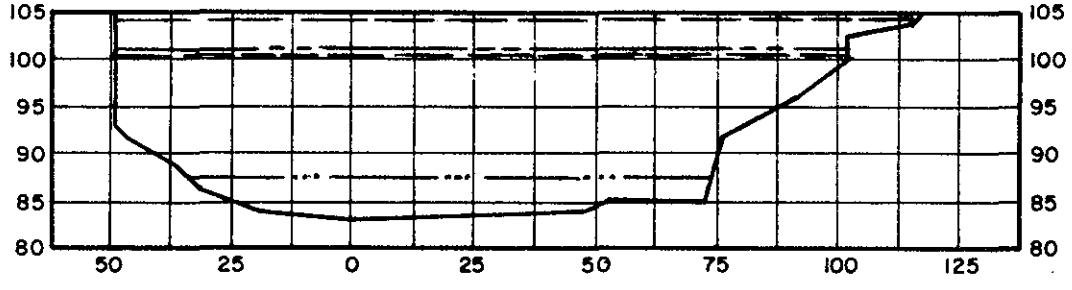
SECTION (1) STA. 9+55



SECTION (14) STA. 187+70



SECTION (22) STA. 332 + 25



SECTION (29) STA. 503+00

NOTES

Sections taken looking downstream
Horizontal distances in feet
Elevations in feet (Mean Sea Level Datum)

LEGEND

——— STANDARD PROJECT FLOOD
— — — AUGUST 1955 FLOOD (MODIFIED)
— — — INTERMEDIATE REGIONAL FLOOD
— ··· — NORMAL FLOW

FLOOD PLAIN INFORMATION
BLACKSTONE RIVER

TYPICAL CROSS SECTIONS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 15